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Sampling the Threat Domain for Efficient Tank Gunnery Training and Testing

Charlotte H. Campbell and R. Gene Hoffman
Human Resources Research Organization

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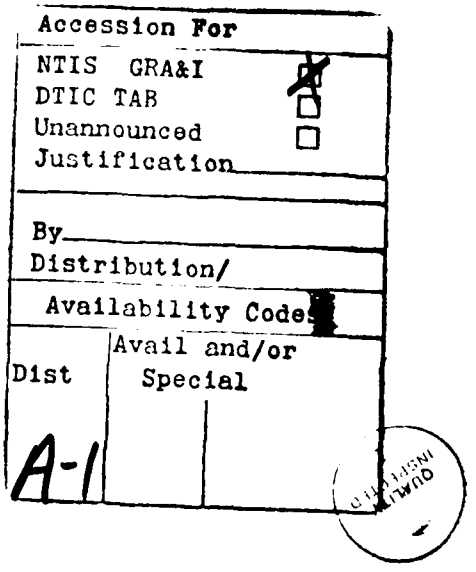

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This research proposes methods for specifying realistic threat-based conditions under which to conduct training and testing. Selection of conditions for training focused on the Mission Essential Task List (METL). Platoon, crew, and individual tasks were included. The procedure was designed to be sensitive to differences in initial task proficiency and difficulty in the importance of tasks depending on the unit's METL.

To develop methods, researchers constructed an algorithm to estimate potential proficiency gains for platoon, crew, and individual tasks that could occur from practicing each of the threat engagements. The algorithm is iterative; on each iteration it selects the engagement that is predicted to provide the maximum payoff in total expected proficiency gain weighted by importance. Subsequent iterations recalculate expected proficiency gains to adjust for the gain expected from the engagements already selected.

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Thus, the algorithm identifies the rank order of engagements for maximizing proficiency gains on important and poorly performed tasks. The algorithm was implemented in a BASIC computer program. Additional support programs were written to input and update changes in tasks and engagements.

The BASIC program should allow unit commanders to rapidly determine which threat-based engagements to use to provide the most beneficial context for training gunnery tasks most closely related to their METL. The algorithm provides a method for guiding research related to particular kinds of gunnery tasks by the identifying threat conditions that require those tasks.

Selection of engagements for testing focuses on crew and platoon subtasks. Engagements are clustered on the basis of their coverage of subtasks. The method comprises decision points in which test constraints are specified that impinge on implementation of engagement conditions and steps that ensure complete coverage of all subtasks.

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FOREWORD

Over the last 5 years, the need to incorporate information concerning threat dispositions and capabilities into statements of conditions and standards for gunnery training has received increased recognition. This research is intended to support that trend by proposing a method for incorporating the use of threat-based gunnery engagements in training and testing. The report is part of a series that addresses each phase of the training design process--from threat domain definition and selection to training objective identification and finally, to training and testing strategy development. The purpose of the research is to ensure that armor platoon training makes optimal use of all gunnery training devices to meet realistic needs of the future battlefield.

This research is a part of the Army Research Institute for the Behavioral and Social Sciences (ARI) task entitled "Application of Technology to Meet Armor Skills Training Needs." It is performed under the auspices of ARI's Armor Research and Development Activity at Fort Knox. The proponent for the research is the Deputy Chief of Staff, Training, Training and Doctrine Command (TRADOC). In addition, the requirement for this research has also been recognized by the Office, Secretary of Defense.

The methods developed will facilitate the systematic and efficient inclusion of realistic threat-defined situations into the training and testing of tank gunnery tasks. Of particular interest to the military community, a method is presented for identifying threat situations to support training of Mission Essential Tasks (METL). Of concern to the research community, an additional method is presented that provides a solution to the rather unique testing problem of identifying test context. While the methods themselves present an important contribution to ARI's 6.2 Exploratory Development program, the results have provided tools that may have immediate application to training and testing decisions for tank gunnery.

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SAMPLING THE THREAT DOMAIN FOR EFFICIENT TANK GUNNERY TRAINING AND TESTING

EXECUTIVE SUMMARY

Requirement:

Previous research, including research in this same work effort, has identified a wide variety of platoon level gunnery engagements defined by threat tactics and deployments. The number of those engagements is far too great for any one unit to possibly cover during gunnery training. A method is needed to reduce the number of threat-defined engagements that might be incorporated in a tank gunnery training or testing program. This report has two purposes. First, it presents an algorithm for setting priorities among threat conditions for training. Second, it describes a method for selecting threat conditions for use in the development of valid and reliable tactical gunnery testing.

Procedures:

Current unit training emphasizes use of the Mission Essential Task List (METL) to identify tasks of critical wartime importance. Given this emphasis, an algorithm was constructed to identify the threat-based engagements that can best support training for a unit's METL. The approach was to adopt a learning curve formula that could be used to estimate increases in task proficiency that might be expected from practicing gunnery in any of the threat engagements. Platoon, crew, and individual tasks were included. The procedure was designed to be sensitive to differences in initial task proficiency, differences in task difficulty, and differences in the importance of tasks depending on the unit's METL.

For testing purposes, the performances of interest were judged to be individual, crew, and platoon subtasks. These differ from METL tasks in their specificity. The goal was to develop a method for delineating a relatively small set of threat conditions that would provide broad coverage of the tactical gunnery subtasks.

Findings:

For training development, an algorithm was constructed to estimate potential proficiency gains for platoon, crew, and individual tasks that could occur from practicing each of the threat engagements. The algorithm is iterative; on each iteration it selects the engagement predicted to provide the maximum payoff in terms of total expected proficiency gain weighted by importance. Subsequent iterations recalculate expected proficiency gains to adjust for the gain expected from the engagements already selected. Thus, the algorithm identifies the rank order of engagements for maximizing proficiency

gains on important and poorly performed tasks. The algorithm was implemented in a BASIC computer program. Additional support programs were written to input and update changes in tasks and engagements.

For testing development, a decision method is outlined that guides selection of threat engagements. It requires user input concerning the subtasks to be tested, environmental conditions and commander behaviors that can be controlled or modified, and decisions on the number of engagements and the number and type of targets that can be presented.

Utilization of Findings:

The BASIC program should allow unit commanders to rapidly determine which threat-based engagements might be used in order to provide the most beneficial context for training gunnery tasks most closely related to their METL. The algorithm also provides a method for guiding research related to particular kinds of gunnery tasks by identifying threat conditions most appropriately requiring those tasks.

The decision method for test development is a straightforward process of examining a subtask by engagement matrix, and selecting the engagements that permit the broadest mix of subtask coverage. The method is flexible in allowing the user to specify the threat conditions that can or cannot be supported, and to select engagement arrays with many or few targets, close or extended ranges, and a variety of threat postures and configurations.

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SAMPLING THE THREAT DOMAIN FOR EFFICIENT TANK GUNNERY TRAINING AND TESTING

Chapter 1: Introduction

One of the basic principles of the Army's FM 25-100, Training the Force (Department of the Army [DA], 1988c), emphasizes the concept "train as you fight" (p. 1-3). It tells leaders that they must "demand realism in training. They must integrate such realistic conditions as smoke, noise, simulated NBC, battlefield debris, loss of key leaders, and cold weather" (p. 1-3). For tank gunnery, combat realistic conditions in training are largely dependent on the threat vehicles, equipment, and arrays that will be faced.

A similar emphasis on realistic conditions exists in testing. Test specialists point out that the interpretation of test results depends in large measure on the correspondence between the method of test administration and the criterion that results are to address. Evidence of validity is provided, in part, by consideration of the degree to which the format and response properties of the sample of items or tasks in a test are representative of the universe. Again, for tank gunnery, the potential threat target arrays are a major parameter defining the gunnery universe.

This report addresses issues of threat realism in both training and testing development. Methods are described whereby training and testing of tactical gunnery for tank crews and platoons within the context of realistic threat conditions may be developed.

Statement of the Problem

Training developers plan and evaluate tactical gunnery training to address those tasks--individual, crew, and platoon--that are required in order to defeat the threat forces on the battlefield. Currently, the Army has in place a system for specifying the tasks that units must be able to perform. That system, described in FM 25-100 (DA, 1988c) is based on the development of a Mission Essential Task List (METL). The METL is "...an unconstrained statement of the tasks required to accomplish wartime missions" (p. 2-4). These critical tasks are defined based on an organization's wartime operations, as supplemented by external directives related to that wartime mission. METL are directed to be established from corps level down through company level, and unit training is to be conducted around the unit's METL.

Tests of tactical gunnery should also focus on essential tasks. Whether the purpose of the test is to assess training, to qualify crews or platoons, or as the criterion in research, if certain tasks are required to accomplish wartime missions, then proficiency on these tasks is the test of readiness. Furthermore, evaluation of mission essential tactical gunnery tasks in any context other than the battlefield itself begs the issue of test results validity. Just as the Army's guidance to units is to "train as you fight," so the guidance to those who would evaluate training or proficiency by means of performance tests must be to "test as you perform." Leaders are directed to demand realism in training, and to integrate conditions that represent the realities of battle. Test developers must likewise introduce realism into the tests so that conclusions concerning tactical gunnery performance are valid in contexts beyond the test itself, i.e., in terms of combat readiness.

There are two problems associated with testing and training in a realistic context. The first is to provide some structuring of the threat context so that it may be systematically, rather than haphazardly, covered in training and testing design. A prior report (Campbell & Campbell, 1990) has accomplished this objective. The second problem associated with providing realistic contexts for training and testing is the efficient sampling of threat conditions for training and test gunnery tasks of interest. Thus, the focus of the present report is to provide methods for sampling the threat domain to facilitate training and testing objectives while at the same time minimizing resource utilization.

Background

Integration of realistic threat conditions, in training and in testing, is more easily said than done, primarily because of the difficulty in pinning down what threat conditions should be anticipated. The threat is expected to present itself in a number of well-defined formations and deployments that depend upon unit (e.g., tank regiment or motorized rifle regiment), mission (e.g., meeting engagement, deliberate attack), and range to the threat objective. Threat doctrine on tactical gunnery is sufficiently well documented (DA, 1984a, 1984b, 1988a) that certain patterns of activity may be predicted, at a reasonable level of confidence, to occur during battle. At the same time, of course, it is recognized that the battle will be a continuous, event-driven series of actions, characterized by apparent chaos.

A recent effort to define the domain of threat situations is described by Campbell and Campbell (1990). They developed a methodology which defined the tactical gunnery presentation and activity of a threat Motorized Rifle Regiment (Warsaw Pact) in terms of mission, range, and numbers of threat vehicles. Doyle (1990) applied the methodology to generate 42 threat engagements, including both offense and defense (summarized in Appendix A). He also identified seven important secondary conditions representing threat battlefield systems (e.g., NBC, helicopter support) which may be presented as additions to the engagements. Further analysis of the methodology led to the conclusion that the threat specifications used to generate the engagements were suitable not only for the present threat, but also for the threat as it is expected to be armed and deployed throughout the next 10 years. The threat engagements produced by Doyle are not a complete and comprehensive depiction of the battlefield. They are, however, a domain sample, generated as a representation of the domain. As such, conclusions drawn on the basis of this sample may be generalized to the domain of threat conditions as a whole.

Thus the threat domain definition methodology represents a comprehensive set of content specifications, from which smaller samples of training or test contents may be drawn. But the threat conditions are only one aspect of the performance domain. The other aspect concerns the tasks and activities required by M1 crews and platoons to successfully perform under the specified conditions. The confluence of tactical gunnery activities and battlefield conditions then constitutes the specification of the domain of tactical gunnery. It is from this set of domain content specifications that conditions for training and testing should be sampled.

It follows that it is necessary, in defining the critical gunnery domain, to enumerate the relevant tasks. The METLs, which comprise the wartime critical tasks, seem to be an obvious source for defining the domain

of gunnery tasks. Yet because of the differences in wartime missions and geographical locations, mission essential tasks may be very dissimilar even among similar type organizations. Therefore, a performance domain task list developed on the basis of one company's METL might not be suitable for another seemingly similar organization. In the case of armor units, the collective tasks in gunnery do in fact accrue to all armor units, and have been compiled for training purposes in the Armor Mission Training Plan (MTP) (DA, 1988b). The MTP does not, however, comprise detailed and specific lists of individual and crew tasks.

Morrison and Hoffman (1988) developed a definition of the gunnery domain in terms of individual behaviors (as well as tank-internal and -external conditions), based on examination of the M1 gunnery manual (DA, 1986) and the M1 operator's manual (DA, 1981). Meade (1989) revised that analysis and produced a listing of all possible engagement patterns for M1 tactical gunnery at the crew level. Some 4600 engagement patterns were identified, in addition to target acquisition and fire effect assessment activities. Morrison, Meade, and Campbell (1990) refined the earlier lists of Morrison and Hoffman and of Meade to develop what they term gunnery subtasks, based on a rational analysis of gunnery training objectives. These subtasks represent trainable task components, and are smaller (encompass less complexity and breadth) than typical armor tasks.

Research Objectives and Organization of the Report

This report documents research efforts on two related objectives. The first concerns the integration of threat-descriptive engagements in operational training. This report details a method for the selection of threat-descriptive engagements to be used in the conduct of training. The selection algorithm includes consideration of not only what tasks (individual, crew, and platoon) can be trained within each engagement, but also recommendations for training based on task learning difficulty and existing task proficiency. The algorithm and its parameters are described; a computer program for using the algorithm is presented, along with instructions for its use, in an appendix.

The second objective pertains to the integration of realistic conditions in testing. A method is described for the selection of threat-descriptive engagements to be used in developing standard tests of tactical gunnery for purposes of training assessment, crew and platoon qualification, and research.

The two chapters which follow deal with these two objectives. Chapter 2 presents the method and results for selecting engagements for training purposes, and Chapter 3 describes the method and results for selecting engagements for use in testing. The final chapter then discusses the implications for future research and methodology development.

Chapter 2: Sampling the Threat Domain for Training

The Army recognizes that training everything is an impossible task. Development of the METL is intended to focus training attention and resources on critical tasks, as demanded by the organization's wartime operations. A subset of METL tasks, called battle tasks, is identified as comprising particularly critical tasks. While a mission essential task is related to the mission of the unit itself, the battle tasks are those tasks that are exceptionally supportive of the mission of the next higher level unit. By doctrine, unit training is to be conducted in response to these designations.

Our approach to sampling threat conditions for training is to rely directly on the METL development system. That is, sampling should select those portions of the threat domain which provide the context for training the tactical gunnery tasks most closely associated with a unit's METL. In a sense, this sampling approach represents a circularity. Wartime operational assignments are analyzed by Army personnel to generate the METL and we are suggesting that the METL be used to identify relevant wartime engagements for training. Our preference for this circular approach is that current training doctrine places a strong emphasis on METL-based training. If direct identification of engagements from operational wartime assignments, without explicit deference to the METL, were to mismatch a unit's METL, training for the METL would naturally be given precedence. Our approach simply recognizes this, and builds into the algorithm a means for considering METL as engagements are selected. In doing so, it also relies on the precision of the METL generation process.

In this chapter, we present the development of an algorithm for METL-based selection of threat engagements for training gunnery tasks. The focus is on platoon gunnery training, but consideration is also given to crew tasks and to individual tasks at Skill Levels 3 and 4. For these tasks, the battalion is the most influential echelon in training development, so the selection system is designed principally for battalion level users. The system is also supportive of other uses. For example, it can be used to guide research related to particular kinds of gunnery tasks by identifying threat conditions most appropriately requiring those tasks.

General Description of the Selection Algorithm

The basic concept for selecting the context for training gunnery is to select threat engagements that best support the training of platoon, crew, and individual tactical gunnery tasks related to a particular METL. Our algorithm for setting the priority of threat engagements is based on learning theory concepts, but it is not presented as a rigorous model of skill acquisition. Rather, it should be viewed as a decision aid, built with simplifying assumptions that represent a compromise between technical complexity and functional economy.

The steps in the algorithm are based on a prediction of task learning from engagement practice. Engagements differ in the practice they can provide, so that those engagements that provide practice for the most tasks are the most beneficial for training. That is, proficiency can be most efficiently obtained by maximizing practice opportunities of important gunnery tasks. Thus, the selection algorithm:

- Recognizes differences in importance of gunnery tasks.
- Considers current proficiency on each task.
- Employs specifications of opportunities for practicing tactical gunnery tasks within the threat-based engagements.
- Estimates learning potential for those tasks as a function of initial proficiency, practice, and task difficulty.
- Estimates expected training utility of each engagement as the sum of potential gain for each task weighted by task importance.
- Iteratively samples (without replacement) threat engagements with the maximum expected utility.

The first and second facets, task importance and initial proficiency, are user inputs to the program. The third facet requires specifications of practice opportunities, by means of a judgmental and doctrinal-based process of identifying the tasks that are likely to occur in each of the different engagements. These specifications are embedded in the selection algorithm. The fourth and fifth facets require the specification and use of appropriate learning curves. The last facet is the straightforward application of utility theory.

Two features of the algorithm warrant further explanation. The first feature concerns task proficiency. According to FM 25-100 (DA, 1988c), training plans should be made in light of current levels of proficiency, that is, training needs to emphasize tasks with lower levels of proficiency. Thus, the algorithm requires estimates of current proficiency. Potential gain from practice on the threat-based engagements is then estimated relative to estimated initial proficiency. Second, the algorithm is structured so as to explicitly recognize that there is more than one way to reach the same end, and that some engagements may substituted for others without altering training efficiency.

Construction of the Algorithm

There were a number of issues that had to be resolved in order to construct an algorithm which begins with a METL and ends with a recommended priority for using threat engagements in gunnery training. These issues include: (a) selection of the type of function to use in the algorithm to relate training to proficiency, (b) scaling of parameters for the chosen training-proficiency function, (c) selection of platoon, crew, and individual tasks for inclusion in the algorithm, (d) generating and incorporating ratings of task training opportunities in the threat conditions (engagements), and (e) considering the number of engagements for training.

Because these issues are not independent, it was not possible to make sequential or independent decisions about them. Rather, as ideas evolved about one area, they forced reconsideration about other areas. In considering these issues, we drew on rationale similar to the work of Sticha et al. (1988), who developed algorithms to set priorities for training device features to optimize training readiness. Their algorithms also incorporated

the use of learning curves, estimation of proficiency gain, and expected utility criteria for selection.

A significant departure from their effort is that we are not attempting to predict transfer of training for device or training event to actual "real world" performance. In their algorithms, transfer estimation was based on estimation of degradation in learning rate due to simulation in training. Their approach began by estimating the learning function based on actual equipment (and we may also assume it is in an actual context). Degradation in learning on a simulator was then factored in. At this stage of our research, we are not yet in a position to estimate these simulator degradations. Thus, the present algorithm identifies engagements that can potentially provide the appropriate, realistic threat-context for practice. That potential is realized only if the local training event conditions allow it.

It must be recognized that a certain amount of parameter estimation is required in working with learning and acquisition models. Errors in estimation, though not usually quantifiable, are generally known to exist. This is acceptable, providing the errors are not so drastic as to reverse selection priorities. Therefore, one goal of the decisions below was to maintain an appropriate, logical balance among algorithm parameters.

Selection of type of training-proficiency function. The purpose of the algorithm is to select training engagements based on anticipated level of proficiency resulting from task practice. Such prediction requires specification of a function relating training to proficiency. Based on reviews of the literature and direct examination of curve shapes, we have selected the hyperbolic function as appropriate for making relative comparisons between levels of training for different tasks.

There is a wide variety of learning curve functions presented in the literature. For example, Sticha et al. (1988) reviewed the power function (popularized by Newell and Rosenbloom, 1981), a linear learning model, and a threshold model. Sticha et al. chose the power function for use in estimating learning on training devices. Their choice was based on the power function meeting two out of three criteria: (1) computational simplicity, (2) applicability to a variety of tasks, and (3) underpinnings in psychological theory. In their opinion, the power function failed the third criterion. However, the others failed in applicability and simplicity.

In a discussion of learning and transfer issues, Spears (1985) describes the use of three additional learning curve formulas: the hyperbolic function, the logistic function, and a version of an exponential function. No particular emphasis was given to any one of the curves, however. On the other hand, Mazur and Hastie (1978) and Pew and Rosenbaum (1988) are supportive of the hyperbolic curve as both applicable to a variety of tasks and consistent with an accumulation model of learning. They particularly rejected the exponential function. The hyperbolic formula is also computationally simple:

Proficiency = Training / (Training + Learning Rate)

The hyperbolic formula, which meets all three of Sticha et al.'s (1988) criteria, was selected for our use. Using this formula, it is possible to predict proficiency based on an amount of training and to predict how much proficiency will improve with additional training. First, however, there

needs to be some fine-tuning of the formula in terms of how to express proficiency, training, and learning rate as mathematical variables.

Scaling of parameters. Having chosen a hyperbolic learning curve function, it was then necessary to specify the scale by which proficiency would be quantified, as well as the scale of values which would describe task learning rate.

A percent proficiency scale ranging from zero to 100% proficient was selected as familiar to the Army and applicable to any task. However, we have also chosen to make a distinction between proficiency and measured performance. That is, even among those who may be able to perform a task 100% correctly (and obtain 100% on a check list test of performance), there are likely to be differences in proficiency that may show up as differences in speed of performance or as differences in the ability to perform a companion task simultaneously with the focal task (the dual task paradigm; c.f., Schriffin, 1988). Thus, 100% performance and 100% proficiency are not synonymous. The 100% level on the learning curve represents asymptotic proficiency at the absolute upper limit of possible performance.

While the learning curve is interpreted in terms of proficiency, observations tend to be on performance. In general, if performance level is described as being at 100%, we may expect that proficiency is something less than 100%, and that there could be benefits from additional training (or overlearning). In addition, in our experience conducting hands-on tests of performance and conducting standard-setting workshops, and in discussions in the literature on standard-setting (e.g., Hambleton, Swaminathan, Algina & Coulson, 1978), judgments of performance consistently overestimate tested capabilities. Thus, if users are asked to estimate initial levels of task performance, we may expect their responses to be overestimates of actual proficiency. Given that conceptual proficiency is lower than tested performance, which is itself lower than rated or estimated performance, we have added a modest correction factor of .9 in our algorithm.

Ratings of current performance level by task are to be provided by battalion level personnel, and expressed in terms of a percentage. The correction factor of .9 is then applied to the rating of performance to yield the proficiency estimate used in the algorithm. For example, input ratings of initial proficiency are to be multiplied by .9, such that rating of 90% average performance would be treated as 81% average proficiency, etc.

Use of a learning curve also requires estimation of a learning rate parameter. This parameter describes the rapidity of learning and may be viewed as distinguishing tasks in terms of learning difficulty. Certainly, tasks are not all alike and there is potentially a wide range in task difficulty. On the other hand, no hard data are available which trace task acquisition time. Therefore, the algorithm takes a conservative approach and distinguishes just two categories of tasks: easy to learn and hard to learn. Easy tasks are arbitrarily defined as tasks that may be learned to 90% proficiency (100% performance) in approximately 5 trials. Hard tasks are arbitrarily defined as tasks that may be learned to 90% proficiency in

approximately 12 trials[1]. Appropriate learning rate parameter values were selected for these two definitions. Figure 1 illustrates the shapes of the hyperbolic learning curves for these two levels of task difficulty.

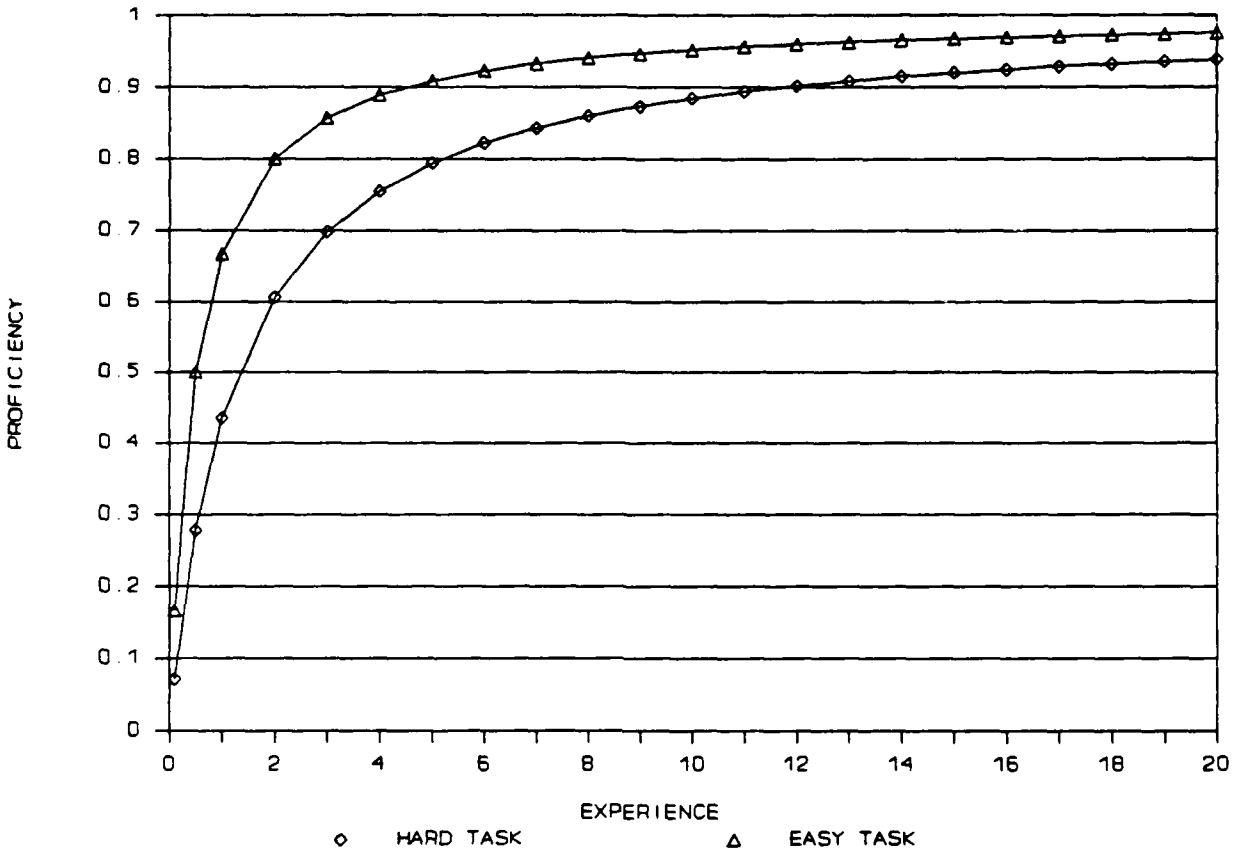

Figure 1. Hyperbolic learning curves used to estimate proficiency gains from task experience.

Task difficulty assignments were initially made by in-house subject matter experts, and then verified or revised by a panel of NCOs from the Weapons Department and from the Command and Staff Department of the Armor School, Fort Knox. Tasks were dichotomously characterized as either easy or hard to learn. Operationally, then, easy-to-learn tasks are those that are learned in 8 or fewer trials, while hard-to-learn tasks require 9 or more trials. The break between 8 and 9 represents the midpoint between 5 and 12, the two anchors for hard and easy tasks.

Selection of tasks. Platoon tasks, crew tasks, and individual tasks were all reviewed for inclusion in the selection algorithm. Sources for these

[1]Although the numbers are arbitrary, e.g., hard tasks could have been defined as requiring something more than twelve trials, the twelve trial definition was acceptable to our SME reviewers.

tasks included both published (DA, 1988b) and unpublished documents (crew and individual task lists provided by the Directorate of Training and Doctrine, USAARMC, Fort Knox, Kentucky). Tasks are differentiated into three categories. One category comprises those tasks that are not required for performance in any of the threat-based engagements. Another category includes tasks that are required for performance in all of the engagements. The third category is composed of those tasks that are required for performance in some of the engagements, but not others. Thus, none of the engagements give practice on the first type of tasks and all of the engagements can give practice on the second type of task. The engagements differ only on the third type of tasks. Therefore, only tasks for this third category can have any impact on the selection computations made by the algorithm and only these tasks are included in the algorithm. They are listed in Table 1. A complete list of the tasks considered appears in Appendix B.

Task training opportunities in threat conditions. The selection algorithm orders engagements in terms of the opportunities they present for practicing each of the important tasks. This represents a compromise. A straightforward solution might have been to describe the amount of repetition each task receives in each engagement. The more times a task is repeated in an engagement, the greater the expected improvement in proficiency. However, it was not possible to construct such designations. For many of the tasks whether or not they are performed in an engagement is problematical. Other tasks are performed by only a portion of the platoon. Still other tasks are essentially continuous in nature and counting repetitions of performance is not reasonable (e.g., wear M25 protective mask). Therefore, instead of amount of task practice per engagement, we used a dichotomous yes/no indication of whether or not an engagement presented the opportunity to practice a task. The judgments were made without regard to specific ways in which an engagement would be practiced (e.g., device, types of ranges). Thus a "yes" rating indicates that a task would normally be practiced during a particular engagement in some method of gunnery practice. On the other hand, a "no" rating indicates that a task would not normally be practiced during a particular engagement in any method of gunnery practice. Entries were initially by in-house subject matter experts. These were then reviewed and revised by a panel of NCOs from the Weapons Department and from the Command and Staff Department of the Armor School, Fort Knox. The task practice opportunity by engagement matrix is presented in Appendix C.

Number of engagements for training. The selection algorithm ranks the threat-based engagements in order of their cumulative contribution to training. That is, the first engagement selected is the one that gives the most training opportunities to tasks that are important and poorly performed. Then, the second engagement selected gives the most additional opportunities, given the training opportunities of the first task. This is repeated for the list of engagements available. The algorithm does not determine the number of engagements that should be practiced. This is for a combination of two reasons. First, gunnery skill should be automatic and resistant to decrements due to stress, fatigue, and overload from additional task demands. Such automaticity is achieved only with repetition. As indicated earlier, there is a difference between proficiency and measured performance. Even after performance reaches 100%, there are increases in proficiency that can be achieved with additional practice. This is the old principle of the benefits of overlearning. Second, given the desirability of overlearning, the number

Table 1

Armor Tasks That Differentiate Threat Engagements

Task Title	Task Number	Difficulty
Platoon Tasks		
Respond to Chemical Agent Attack	03-3-C015	E
Employ Electronic Counter-Countermeasures	17-3-0103	E
Execute Wedge Formation	17-3-0205	E
Execute Vee Formation	17-3-0206	E
Execute Line Formation	17-3-0207	E
Execute Echelon Formation	17-3-0208	E
Execute Traveling	17-3-0209	E
Execute Traveling Overwatch	17-3-0210	E
Execute Bounding Overwatch	17-3-0211	E
Perform Platoon Fire and Movement	17-3-0217	E
Perform Reconnaissance by Fire	17-3-0218	E
Perform Attack by Fire	17-3-0219	H
Assault Enemy Position	17-3-0220	H
Execute Actions on Contact	17-3-0221	E
Occupy Platoon Battle Position	17-3-0222	H
Displace to Subsequent Platoon Battle Position	17-3-0223	E
React to Enemy Dismounted Attack	17-3-0224	E
Execute Platoon Defensive Mission	17-3-0225	H
Take Actions at Obstacle	17-3-0401	H
Respond to Residual Effects of Nuclear Attack	17-3-0409	E
Take Active Air Defense Measures	44-3-C002	E
Change Formation Drill	BD 1	E
Action Drill	BD 2	E
Contact Drill	BD 3	E
Air Attack Drill	BD 4	E
Indirect Fire Drill	BD 5	E
Crew Tasks		
Engage Targets from Sketch Range Card on M1/M1A1	5560	H
Engage Multiple Machine Gun Targets from M1/M1A1	5585	E
React to Indirect Fire (Crew)	5893	E
Skill Level 4 Tasks		
Conduct Hasty Assault Breach of a Minefield	051-192-4046	E
Organize Platoon for Night Defense	071-326-5515	H
Coordinate With Adjacent Platoon-size Elements	071-326-5775	E
Direct Platoon Fires in Defense	071-326-5780	E
Control Techniques of Movement	171-121-3009	E
Skill Level 3 Tasks		
Implement MOPP	031-503-3008	E
Select Firing Positions	171-123-1002	E

of engagements that should be practiced is driven more by resource constraints than by proficiency considerations. That is, given current resources, it is probably not possible to practice too much. Thus, the decision about how many engagements should be included in training is left to the user.

Method for Selecting Engagements for Training

In this section, the operation of the algorithm itself is described. It is based on attaining maximum training utility from the selected engagements for the tactical gunnery tasks of greatest importance and lowest current proficiency. Three protocols for engagement selection are considered, depending on the training orientation of the developer.

Maximum expected training utility. The expected training utility for each engagement is the weighted sum of estimated proficiency gains across tasks.

Expected training utility =
(Importance (Task A) X Proficiency Increment (Task A)) +
(Importance (Task B) X Proficiency Increment (Task B)) +...+
(Importance (Task N) X Proficiency Increment (Task N))

For each task, an initial level of proficiency is determined based on input estimates of current performance made by the user. In Figure 2, for example, two tasks may be estimated to have current performance at the 70 percent level. The 70 percent performance is translated into 63 percent proficiency. For an "easy" task, 70 percent initial performance is marked at point A1. For a "hard" task, 70 percent initial performance is marked at point B1. These proficiency levels represent the start points for these particular tasks along the learning curves.

Then for each combination of task and engagement, an expected increment in proficiency is estimated. If an engagement does not provide any practice opportunity for a task, the expected increment in proficiency is zero. Otherwise, the increment is a function of initial proficiency level (the start point) and task difficulty (which curve is being used). Thus for the easy task in Figure 2 with initial proficiency of 63 percent, the expected proficiency increment is represented by the difference between A1 and A2. For the hard task with initial proficiency of 63 percent, the expected proficiency increment is represented by the difference between B1 and B2.

These increments are then weighted (multiplied) by task importance estimates, which are provided by the user, to give a training utility estimate. For our sample tasks that begin at A1 and B1 in Figure 2, if they have equal importance, training the easy task has greater utility than training the hard task (the A1 to A2 increment is larger than the B1 to B2 increment). However, if the hard task is more important, multiplying the performance increment by importance will yield a greater training utility for the hard task.

Finally, for each engagement, the weighted proficiency estimates for all tasks are summed. Thus, for the sample tasks in Figure 2 that begin at A1 and B1, an engagement that provides practice to both tasks would have the utility associated with increasing performance on both tasks. On the other hand, an engagement that gives practice on only one of the tasks will have only the

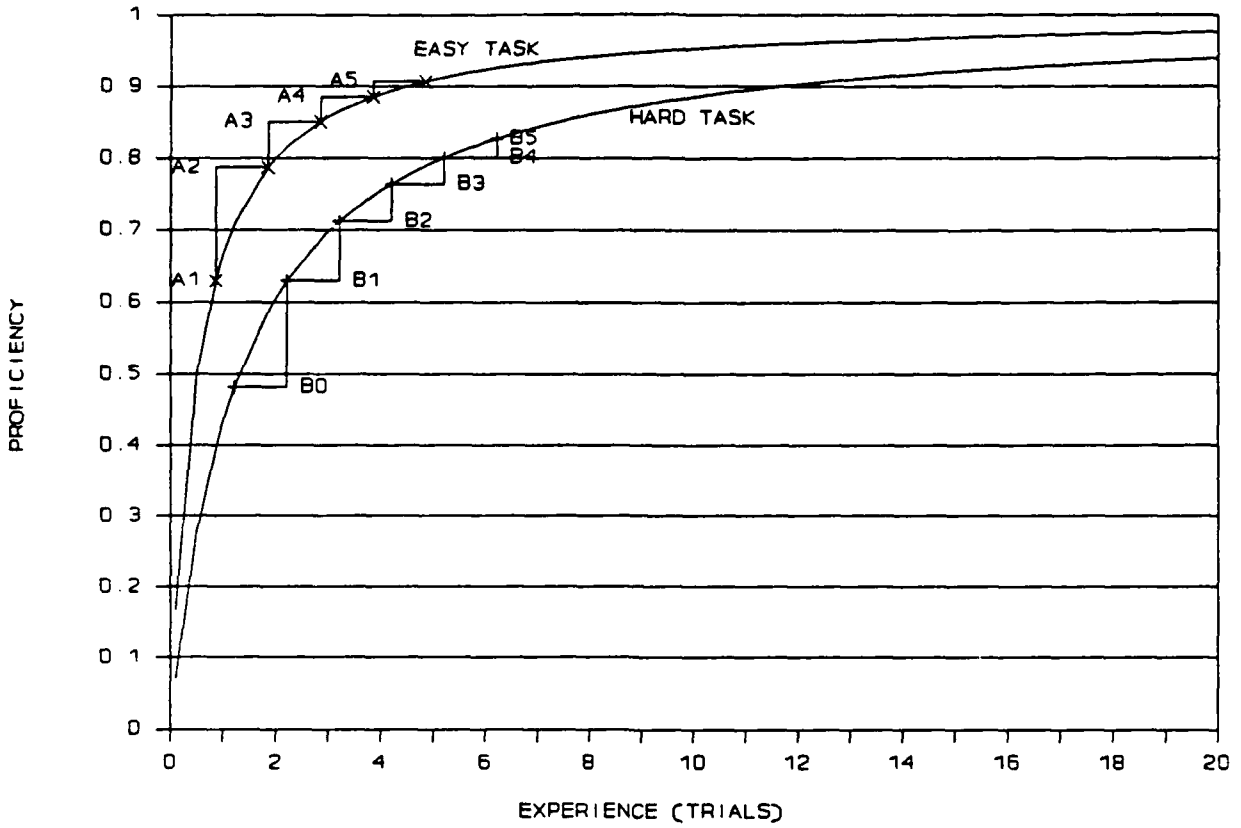

Figure 2. Example improvement predictions for sample "hard" and "easy" tasks.

utility associated with that one task. The algorithm then identifies the engagement with the largest (maximum) expected utility as the most advantageous for training. On the first iteration of the algorithm, the maximum expected utility for an engagement represents the initial expected training utility for that engagement.

Once the first engagement with the maximum expected utility is identified, the algorithm repeats to select additional engagements. However, expected utilities are recalculated to adjust for the expected increases in task proficiency based on the practice opportunities that can be provided by the selected engagement. Thus, the increases in tasks' proficiency projected from the selected engagement are assumed to have occurred. Proficiency gains for selecting succeeding engagements are calculated from the new levels of expected proficiency. As each subsequent engagement is selected, the practice opportunities it provides are cumulated with those of the previously selected engagements, new levels of expected proficiency are calculated, and subsequent expected gains calculated from those new levels. In addition, the selected engagement is no longer considered for selection.

Thus, again consider the two sample tasks in Figure 2 that begin with initial proficiency at A1 and B1. Now consider engagements that allow practice only on the easy task (which may be called Engagement A, A', A",

etc.) and engagements that allow practice only on the hard task (called Engagements B, B', B", etc.). Given equal levels of importance, one of the A engagements (e.g., A) is selected first. Now Task A is at A2 while Task B is still at B1. On the next iteration of the algorithm, one of the B engagements (e.g., B) is selected because the difference between B1 and B2 is greater than the difference between A2 and A3. For the third iteration, the A task is at A2 and the B task is at B2, so the A2/A3 difference is compared to the B2/B3 difference, the A2/A3 difference is larger, and another A engagement (e.g., A') is selected. Based on similar comparisons of expected proficiency increments, the subsequent two iterations select B engagements (e.g., B' and B").

There are several observations concerning the selection preferences inherent in the calculations of the algorithm. First, because of the changing slope of the learning function (and other things being equal), a greater change in proficiency per practice opportunity is expected for tasks with lower proficiency. Therefore, the algorithm will give preference to selecting engagements that allow practice on tasks with lower initial levels of proficiency. Thus, consider two hard tasks, one with initial proficiency at B0 in Figure 2 and one with initial proficiency at B1. Engagements that support practice of a task at B0 have greater utility than engagements that support a task with initial proficiency at B1. However, because the algorithm is iterative, at some point anticipated proficiency increments for tasks with the initially lower proficiency will be smaller than the initial proficiency increments of other tasks that have not yet been allocated practice. Priorities will then shift to the tasks that initially were better performed tasks. In our particular example, practice on an engagement that only supports training on the task at B0 only will bring it up to B1 and the task that started at B1 will remain at B1. At this point, the two tasks are equal.

A second observation is that, given equal levels of proficiency and equal importance, expected gain from practice will be greater for easy tasks than for hard tasks. Therefore, given that everything else is equal, the algorithm will select an engagement that gives practice to easy rather than hard tasks. Thus, starting again at A1 and B1 in Figure 2, an engagement that supports practice of an easy task would be selected prior to an engagement that supports practice of a hard task. This is because the difference between A1 and A2 is greater than the difference between B1 and B2. This may seem counterintuitive. That is, it seems that more practice should be given to hard tasks and that the algorithm should give preference to hard tasks. There are two reasons why this argument is faulty. First, by assuming that two tasks are equal in importance, we are assuming that expected proficiency gains are indicative of increase in utility. Giving priority in training to the easy task will result in more immediate benefit. Second, the algorithm is iterative. Again, if everything else is equal, after an engagement is selected to give practice to easy tasks, projected proficiencies for those tasks (used in selecting the next most beneficial) are higher and the expected gains for additional practice are lower than before. Therefore on subsequent iterations, as practice and proficiency are added to the easy tasks, their expected gains decrease. If practice is not assigned to the hard tasks, then their expected gains have remained constant. Again, in example tasks from Figure 2 that begin with proficiency at A1 and B1, engagements that support the easy task would be selected first. Assuming that the selected engagement does not give practice to the hard task (the B task), the next iteration of the algorithm would be comparing the difference between A2 and A3 to the

difference between B1 and B2. In this case, the B1/B2 difference is greater and an engagement that supports practice of the hard task would be selected. Sensitivity analysis of the algorithm reveals that, given equal initial level of proficiency, for most locations along the curve no more than two iterations of the algorithm would give preference to engagements that provide practice to the easier task. Then, the relative gain for the easy task would diminish enough for the algorithm to select the harder task, other things being equal.

A third observation is that if the algorithm is used to identify a particular number of engagements for training, the selected engagements give the maximum expected proficiency gain, adjusted for task importance, that can be achieved by any combination of that particular number of engagements. Furthermore, total expected gain in proficiency for that set of engagements is a function of the total number of practice opportunities provided by the whole set. Once a particular number of engagements is selected, total practice, and therefore total expected proficiency gain, are independent of the order in which these engagements were selected. Thus, once a particular size set of engagements is selected, there are no implications for sequencing training based on the order of the selection. The order for actually practicing the tasks is not specified by the algorithm.

The above observations relate to features inherent in the algorithm. A final observation concerns the impact that the importance weights have on the selection process. Engagements should be selected to give practice to the more important tasks if everything else is equal. In addition, it was decided that engagements should be selected to give practice to the more important tasks even when the tasks differ in difficulty. Given that proficiency gain for the easier task will be larger than for the harder task, if the hard task is more important, the importance multiplier should be great enough for the utility of the expected gain (i.e., gain times importance) to be larger for the hard but important task. Importance was weighted in the algorithm to insure that this would occur. For a multiplicative function, the appropriate method for weighting one variable over another is by raising it to some power. Thus, while importance ratings are made on a 1 to 3 scale, they are squared in the algorithm.

Note that task importance does not have to be differentiated. That is, some users may chose to make all tasks equal in importance, giving them all the same weight in the selection algorithm. Some may prefer to make a dichotomous distinction between tasks that are important and tasks that are not important. This distinction could be made by assigning weights of two or one to distinguish between important and unimportant tasks.

Engagement selection protocols. The algorithm has been structured with options to permit the user to focus on any one of three "levels" of engagement. These three levels derive from integral features of the engagements themselves, introduced at the time of methodology development (Campbell & Campbell, 1990).

The Doyle (1990) engagements, which represent the threat domain as defined by that methodology, are structured to portray potential sequences or snapshots of engagement events, plus a set of "enhancements" to use in combination with these engagements to add requirements for NBC, air defense, reaction to indirect fire, etc. There are six initial scenarios which represent potential starting points of a dynamic battle. For each initial

scenario there are a series of subsequent engagements that represent ensuing points in the battle as forces move in time and space. For training, these engagements may be presented in any of three different ways. First, the initial and subsequent engagements may be treated as separate and independent engagements. This is similar to current configurations of Table VIII. No battlefield time or space relationships are implied between or among the separate tasks of Table VIII. In this treatment, the 42 individual engagements plus the engagement enhancements are distinct, and engagements are selected independently of the initial scenario set to which they belong. Selection of an engagement enhancement means that the additional requirement imposed by the enhancement be added to one of the selected engagements.

A second view for training is to treat the subsequent engagements as a set, presenting the separate target arrays in sequence. The recent Table XII, designed by the Directorate of Training and Doctrine at the Armor School, Fort Knox is an example of this training technique. The live fire exercise at the National Training Center is another. In each case, the static target arrays represent advancing Red forces with targets first presented at long ranges and then successively shorter ranges. For each of Doyle's (1990) six initial scenarios, there are two sets of subsequent engagements differing in the numbers of Red vehicles that are attrited as the forces advance (i.e., a low attrition rate as the vehicles advance, and a high attrition rate as the vehicles advance). Thus, 12 different sets of sequentially related engagements are defined, each composed of either the high attrition rate or low attrition rate subsequent engagements. In this treatment, the 12 sets, plus the enhancements, are the candidates for selection. The selection is based on the combined practice opportunities of the individual engagements comprised by each sequential set. Selection of a engagement enhancement means that the additional requirement imposed by the enhancement must be added at some point to presentations of the selected advancing engagements.

A third view is to treat the initial scenario as the starting point of a dynamic force-on-force free play training exercise. In this case the exercise itself will define the character of the advancing target arrays. The subsequent engagement descriptions are not needed. In this application, the selection is simply among the six initial scenarios, with the enhancement conditions as required. Selection among the six is based on the combined practice opportunities of the initial scenario plus both high attrition and low attrition subsequent engagements comprised by the initial scenario. Again, the enhancements are added to the increase domain coverage.

Thus, the Campbell & Campbell (1990) methodology was constructed to support training of independent engagements, training of static arrays sequenced to represent a dynamic battle, or force-on-force free play training. The selection algorithm is built to accommodate that flexibility by being structured to handle selection of threat engagements for any of those three training strategies.

Interchangeability of engagements. Another feature of the algorithm is the treatment of identical practice opportunity profiles among the engagements. There are engagements that are identical in terms of the practice opportunities they provide to the platoon, crew, and individual tasks. At any point in the selection routine, those engagements are all equal in their training utility. If the utility value indicates that one of those

engagements should be selected, then, in fact, any one of those could be selected, with no differential outcomes later in the selection process.

Cluster memberships (shown in Appendix A) for engagements were determined by a straightforward examination of practice profiles. Engagements with identical practice values for all tasks were clustered together. Because the profile of task practice values is the only characteristic of engagements that differentiates them, with regard to the selection algorithm, then engagements with identical profiles are in fact identical for the algorithm.

Computer Programs to Support the Task Selection Algorithm

The programming for selecting engagements for training comprises three related programs, each written in BASIC for IBM PC/XT/AT compatibles. The first program, TASKENG, was constructed to create and revise files containing task descriptions and engagement descriptions. The second program, PDATASET, was written to enter the task by engagement practice values and the task difficulty levels. These two programs merely facilitate the creation of the data files of tasks, engagements, and the task by engagement training opportunities matrix. Finally, the third program, SELECT, implements the selection algorithm to rank order the engagements for inclusion in training. The programs are all menu driven. Users are walked through the programs from directions provided on the screen.

Appendix D of this report is a detailed guide to use of the three programs. Complete program listings are in Appendix E, and sample output from the SELECT program is at Appendix F. A brief summary of the SELECT program is presented below.

The selection algorithm is executed by means of the SELECT program. It accesses the information entered using Programs TASKENG and PDATASET, as well as information entered by the user, to select engagements for training purposes in an order that maximizes opportunities for practice on tasks that are important, that most require practice (current proficiency is low), and that are most quickly learned. The program requires the user to decide whether to select from the full set of engagements and enhancements, from among the sets of situationally related engagements, or from force-on-force initial scenario start points.

Program SELECT accesses the TASK file (created by means of Program TASKENG) to prompt the user for task importance values and current percent performance values. The program then implements the iterative maximum expected utility routine described above. The task learning difficulties, importance, proficiency values, and calculated initial levels are printed.

For any of the three protocols (from all engagements, from sets of situationally related engagement, or from scenarios), the program selects without replacement, treating enhancements the same as engagements. The output consists of a listing of the engagements (or engagement sets, or scenarios) and enhancements in the order in which they were selected, along with the engagement descriptions from the ENG file (created by means of Program TASKENG). If selecting for individual engagements, the output also indicates what other engagements, not already selected, could be substituted for the selected engagement, providing the same practice opportunities. If selecting for sets of situationally related engagements, all engagements

contained in the selected set are printed. Finally, to aid the decision about how many engagements to use in practice, the output provides a running tally of the numbers of tanks, BMPs, troops, and other systems required as targets.

Summary

Current training doctrine emphasizes the importance of incorporating realism in training events. For M1 gunnery that includes setting up ranges and training exercises that mimic the threat. Previous research, including research in this same work effort, has identified a wide variety of platoon level gunnery engagements that are representative of threat tactics and deployments. The number of those engagements is far too great for any one unit to possibly cover during gunnery training. A method is needed to reduce the number of threat-defined engagements that might be incorporated in a tank gunnery training program. This report presents an algorithm for setting priorities among these threat conditions.

Unit training plans are centered on use of the METL to identify tasks of critical wartime importance. Given this emphasis, an algorithm was constructed to identify the threat-based engagements that can best support training for a unit's METL. The approach was to adopt a learning curve formula that could be used to estimate increases in task proficiency that might be expected from practicing gunnery in any of the threat engagements. Platoon, crew, and individual tasks were included. The procedure was designed to be sensitive to differences in initial task proficiency, differences in task difficulty, and differences in the importance of tasks depending on the unit's METL.

An algorithm was constructed to estimate potential proficiency gains for platoon, crew and individual tasks that could occur from practicing each of the threat engagements. The algorithm is iterative; on each iteration it selects the engagement that is predicted to provide the maximum payoff in terms of total expected proficiency gain weighted by importance. Subsequent iterations recalculate expected proficiency gains to adjust for the gain expected from the engagements already selected. Thus, the algorithm identifies the rank order of engagements for maximizing proficiency gains on important and poorly performed tasks. The algorithm was presented in a BASIC computer program. Additional support programs were written to input and update changes in tasks and engagements.

The BASIC program should allow unit commanders to rapidly determine which threat-based engagements might be used in order to provide the most beneficial context for training gunnery tasks most closely related to their METL. The algorithm also provides a method for guiding research related to particular kinds of gunnery tasks by identifying threat conditions most appropriately requiring those tasks.

Chapter 3: Sampling the Threat Domain for Testing

In the arena of testing, the validity of interpretations of the results depends on the degree to which the test conditions match those real-world conditions in which the behaviors or knowledges are required. Thus, for example, a written knowledge-based test for tank platoons might be considered to provide a valid measure of the crews' mastery of the cognitive aspects of tactical gunnery, or recognition of switch positions. Most would agree, however, that the test would not provide valid information on the platoon's ability to coordinate, acquire targets, engage targets, or perform other required skills.

Substituting a hands-on job sample test of gunnery skills would not necessarily guarantee greater validity of interpretations of skill. If such a hands-on test required the platoon to perform on a low fidelity simulator with static targets, and no time constraints were imposed, it would certainly be observed that the stresses present under actual combat conditions were absent, and that the test provided only the most basic indications of mechanical or motor skill.

Were the hands-on test to be administered by means of a high fidelity, real-time, simulated battle on terrain with tanks and opposing forces, the test would be more acceptable as a valid measure of tactical gunnery skills. And finally, by observing the platoon performing in a real battle, monitored (and evaluated) by an acknowledged expert, confidence in the validity of the results would be very high.

In summary, then, confidence in the results of a written test would be very low, while confidence in measures obtained by use of high fidelity simulators[2] would be somewhat higher. Confidence in the validity of the test results would be greatest if the unit were measured under actual combat conditions. None would suggest that conflicts be provoked for the purposes of testing the mettle and skill of armor units. Several steps removed from such action is the notion of testing units in the context of simulated threat conditions, where the "enemy" is proactive as well as reactive, and where force-on-force exercises may be played.

The central theme here, obviously, is the notion of realism in testing. By realism is meant not some abstract philosophy of accounting for every possible condition that is expected to be operative at the time of a future battle. Rather, realism is constrained to pertain only to those conditions that are relevant to tactical gunnery. Such conditions would include actual or simulated tanks, terrain, enemy forces, and live fire, but would not compel the crewmembers to eat battle rations or live under battle conditions for some period of time prior to testing.[3]

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[2]Note that a high fidelity simulator need not be a full performance simulator. It must, however, be of high fidelity in eliciting those behaviors for which we wish to make valid inferences.

[3]In fact, it seems to be accepted that the mental and physical stamina of soldiers will be among the most pertinent determinants of battle outcomes. Thus, while at the National Training Center (NTC), soldiers do in fact live as though they are at war, for a short period of time.

The National Training Center (NTC), designed as a training facility, is regarded by many as also being a high-fidelity testing facility in that it permits as close a representation of actual combat conditions, without live fire, as is presently technologically possible. The drawbacks to NTC as a testing facility include the difficulties associated with scoring of free-play exercises and the limited availability of NTC for large numbers of armor units. As a practical matter, the latter consideration is probably more important. But the inability to obtain comparable measures on platoons in genuine free-play situations is a major stumbling block in test construction. If a strong argument cannot be made for the parallel nature of unpredictable events, then conclusions based on measurement during those events are necessarily specious. However reliable the measurement itself might be, the fact that the tests (i.e., test conditions) are different invalidates claims of reliability of measurement across platoons. It is necessary to know, with some certainty, that every platoon tested will be required to demonstrate the same set of tactical gunnery activities. That is, it is necessary that the test conditions be standardized.

In this chapter we describe a method for the selection of threat-descriptive engagements to be used in developing standard tests of tactical gunnery. Such tests are designed for use in training assessment and gunnery research, but they could also be used for crew and platoon qualifications. The method selects threat conditions that provide coverage of tactical gunnery activities for individual crewmen, crews, and platoons. Options within the method permit the introduction of decisions regarding which activities are of interest for testing. No concerted attempt is made, in the method itself, to link engagements to simulator devices, nor to link testing of specific activities to simulator devices. However, the notion that such threat-based testing would be conducted by means of one or more simulator devices was never far from our thoughts. Anticipating the simulator devices that would most likely be employed guided development of the methodology at several points. That is, although no recommendations are made regarding choice of simulator devices for particular purposes, yet the methodology incorporates decision nodes for the user who must make such choices.

General Description of the Method

The two central features of the method are that:

- It selects threat-realistic conditions under which to test platoon tactical gunnery (realism).
- It selects testing conditions in which we know, with reasonable certainty, what activities the crews will be required to demonstrate (standardization).

The first feature, realism, is relevant to considerations of the validity of test results. The second feature, standardization, is at the heart of measurement reliability, which is itself a limiting factor in validity.

The realistic threat conditions which are candidates for selection are those of Doyle (1990), developed by means of the threat domain definition methodology of Campbell & Campbell (1990). The list of candidate activities that the crews and platoons are to demonstrate for testing purposes is derived from the work of Morrison et al. (1990). A matrix of gunnery activities by threat conditions serves as input for the method; cell entries for the matrix indicate whether or not the threat condition will require performance of the activity, permit performance of the activity if additional constraints or modifications are introduced, or neither require nor permit performance of the activity.

Development of the Method

The work of Morrison et al. (1990) provided the basis for construction of the matrix of gunnery activities by threat engagement conditions. They include in their report such a matrix, where the threat engagement conditions are the 42 engagements developed by Doyle (1990). The gunnery activities (called "subtasks" in the Morrison et al. report) at the individual crewmember and tank crew levels were identified by means of two converging efforts: one consisted of successive subdivisions of the major tactical gunnery activities identified by Hoffman and Morrison (1988); the other involved successive regroupings of detailed specifications of tactical gunnery behaviors from Morrison and Hoffman (1988) and Meade (1989). Five criteria were imposed on the resultant lists to inform analysts on when to stop subdividing or regrouping; that is, the five criteria define the characteristics of a subtask. The final list comprised 65 individual and crew terminal subtasks, shown in Table 2.

Identification of the platoon leadership and collective subtasks likewise involved two converging efforts. One consisted of specification of supporting platoon level subtasks for the broad tactical functions of movement, position, firepower, and coordination; the other involved selection of gunnery-supportive tasks from existing doctrinal sources. The resulting lists were merged to produce a single list of 7 platoon leadership subtasks (thenceforth considered as individual subtasks) and 19 platoon collective subtasks (Table 3).

Analysts then made judgments for each subtask by engagement combination as to whether the subtask would occur within the engagement as presently stated, or would occur within the engagement only if certain additional conditions were added, or would simply not occur within the engagement. If additional conditions were required, the analysts specified what those conditions were. Analysts made their ratings on the assumed situation of a full fidelity testing facility; that is, no assumptions concerning simulator capabilities were made.

The matrix was then analyzed in an effort to discover whether any irrelevant subtasks had been included, to identify patterns of subtask requirements across engagements, and to collapse engagements where possible in order to eliminate redundancies. Because the analysis outcome was markedly disparate for individual and crew subtasks, as opposed to platoon collective subtasks, the analysis results and subsequent activities for the two sets of subtasks are discussed separately in the following two sections.

Table 2

Individual and Crew Subtasks for Tactical Gunnery

	Crewmember
2. ACQUIRE TARGET	
2.1. Search/Detect Target(s)	
2.1.1. Choose sight for search	GNR
2.1.2. Search using daylight sight(s)	TC, GNR
2.1.3. Search using thermal sight(s)	TC, GNR
2.1.4. Search -- closed-hatch	TC, LDR, DVR
2.1.5. Search -- open-hatch	TC, LDR, DVR
2.2. Locate/recognize target	CREW
2.3. Estimate range	
2.3.1. Estimate range visually	TC
2.3.2. Range to target with TC's weapon[a]	TC
3. ISSUE FIRE COMMAND	
3.1. Standard fire command	
3.1.1. Issue standard fire command	TC
3.1.2. Lay main gun for direction	TC
3.1.3. Specify direction	
3.1.3.1. Specify direction verbally	TC
3.1.3.2. Mark target with TC's weapon[a]	TC
3.1.4. Specify range	TC
3.2. Issue battlesight fire command	TC
3.3. Specify multiple target engagement sequence	TC
3.4. Specify simultaneous engagement	TC
4. ENGAGE SINGLE MAIN GUN TARGET USING PRECISION GUNNERY	
4.1. Fire main gun at target	
4.1.1. Set FCS switches per fire command	GNR
4.1.2. ID specified target(s)	GNR
4.1.3. Track target	GNR
4.1.4. Lase to target	GNR
4.1.5. Fire at target	GNR
4.2. Maneuver tank	
4.2.1. Direct tank movement (issue driving commands)	TC
4.2.2. Clear terrain mask	GNR
4.2.3. Maintain platform/move to defilade/stop smoothly	DVR
4.2.4. Use cover and concealment	DVR
4.3. Load round	LDR
5. ENGAGE [SINGLE] COAX TARGET PRECISION TECHNIQUE	
5.1. Engage target with COAX	
5.1.1. Engage point target with COAX	GNR
5.1.2. Engage area target with COAX	GNR
5.2. Monitor COAX ammo feed	LDR
6. ENGAGE [SINGLE] TARGET UNDER DEGRADED CONDITIONS	
6.1. Choose degraded mode technique	
6.1.2. Manually index range	
6.1.2.1. Index range using manual battle range add/drop toggle	TC
6.1.2.2. Index range thru computer control panel	GNR
6.1.3. Choose appropriate sight	GNR
6.1.4. Apply range in GAS	GNR
6.1.5. Apply lead to moving target	TC, GNR
6.1 6. Use manual control handles/blasting machine	GNR
6.2. Employ multiple return strategies	TC, GNR

(table continues)

(Table 2 continued)

	Crewmember
7. ENGAGE TARGET FROM TC POSITION	
7.1. Engage main gun target with TC's position	
7.1.1. Set FCS switches per fire command	TC
7.1.2. Track target	TC
7.1.3. Lase to target	TC
7.1.4. Fire at target	TC
7.2. Engage COAX target from TC's position	
7.2.1. Engage point target with COAX	TC
7.2.2. Engage area target with COAX	TC
7.3. Engage target with caliber .50	
7.3.1. Apply range in TC's wpn station sight	TC
7.3.2. Lead moving target	TC
7.3.3. Engage target	
7.3.3.1. Engage point target with cal .50	TC
7.3.3.2. Area target	TC
8. ENGAGE TARGET FROM LDR'S STATION	
8.1. Engage point target with loader's M240[a]	LDR
8.2. Engage area target with loader's M240	LDR
9. ENGAGE MULTIPLE TARGETS	
9.1. Engage multiple main gun/COAX targets (sequential)	
9.1.1. Engage multiple targets from gunner's station	
9.1.1.1. Main gun	GNR
9.1.1.2. COAX	GNR
9.1.2. Engage multiple targets from TC's station	
9.1.2.1. Main gun	TC
9.1.2.2. COAX	TC
9.2. Engage multiple targets simultaneous	
9.2.1. Main gun/cal .50	TC
9.2.2. COAX/cal .50	TC
10. ADJUST DIRECT FIRE	
10.1. Observe fall of round	CREW
10.2. Announce subsequent fire command, REENGAGE, or CEASE FIRE	TC
10.3. Employ reengagement or standard adjustment	GNR
11. TAKE IMMEDIATE ACTION	
11.1. Perform main gun misfire procedure	GNR
11.2. Perform machine gun failure to fire procedure (COAX)	GNR
11.3. React to runaway firing (COAX)	GNR
11.4. Perform machine gun failure to fire procedure (Cal .50)	TC
11.5. Perform machine gun failure to fire procedure (loader's M240)	LDR
12. EMPLOY SMOKE	
12.1. Employ smoke grenades	TC
12.2. Employ vehicle exhaust smoke screening system	DVR
13. REPORT	
13.1. Provide spot report	TC

Note. Adapted from Morrison et al. (1990).

[a]Subtasks dropped.

Table 3

Platoon Leadership and Collective Subtasks for Tactical Gunnery

Leadership Subtasks (Platoon Leader/Platoon Sergeant)

13. REPORT
    13.2. Platoon Leader/Platoon SGT reports
    13.2. Issue/receive report

14. ISSUE PLATOON FIRE COMMAND

15. REQUEST INDIRECT FIRE
    15.1. Request initial indirect fire
    15.2. Shift/lift fire

16. SPECIFY MOVEMENT
    16.1. Specify movement formation
    16.2. Specify movement technique
    16.3. Specify direction

Platoon Collective Subtasks

1. TRAVEL IN PLATOON FORMATION
    1.1. Execute a Wedge Formation
    1.2. Execute an Echelon Formation
    1.3. Execute a Line Formation
    1.4. Execute a Vee Formation
    1.5. Execute a Column or Staggered Column

2. EXECUTE BATTLE DRILLS
    2.1. Execute Action Drill
    2.2. Execute Contact Drill
    2.3. Execute Air Attack Drill

3. BOUND BY SECTION

4. OVERWATCH BOUNDING PLATOON

5. OCCUPY A BATTLE POSITION
    5.1. Occupy Initial Battle Position
    5.2. Occupy Subsequent Battle Position

6. MANEUVER WITHIN A BATTLE POSITION

7. EMPLOY FIRE PATTERNS
    7.1. Employ Frontal Fire
    7.2. Employ Cross Fire
    7.3. Employ Depth Fire

8. EMPLOY FIRING TECHNIQUES
    8.1. Employ Observed Fire
    8.2. Employ Alternating Fires
    8.3. Employ Simultaneous Fires

Note. Adapted from Morrison et al. (1990).

Individual and crew subtasks by engagement. Examination of the matrix revealed that three subtasks from the 72 individual (including leadership) and crew subtasks would only be required by any engagement under highly contrived and artificial conditions; for this effort those three subtasks (2.3.2, Range to target using cal .50 machine gun; 3.1.3.2, Mark target with cal .50; and 8.1, Engage point target with loader's M240 machine gun) were dropped. At the same time, two subtasks were added: Engage aerial target with loader's M240 machine gun (Subtask 8.3), and Observe effect of round (Subtask 4.4.2). Additionally, Subtask 10.1 (Observe fall of round) was moved from the major task Adjust Fire to the major task of Engage Main Gun Target, and renumbered as Subtask 4.4.1. This adjustment was made to more accurately represent the occurrence of the subtask. These changes are shown incorporated in Table G-1.

Further examination of the matrix, in the portion covering individual and crew subtasks, revealed considerable dependency on interforce range in the engagements. That is, some subtasks would simply not occur in engagements where the threat was at extended ranges, and others would not occur at extremely close ranges. Three consistent patterns were found: one pattern held (except for three subtasks) for both high and low Red loss rates for the Blue defensive engagements (excluding against Red breakthrough), a second held (except for two subtasks) for high and low Red loss rates for the Blue offensive engagements, and the third pattern held for high and low Red loss rates in the Red breakthrough/Blue defense engagements. Therefore, the engagements were clustered into four engagement clusters for Blue defense, four engagement clusters for Blue offense, and four engagement clusters for Red breakthrough; in each case, the four engagement clusters are differentiated by interforce range, and represent the 2-6 engagements that are portrayed at the same range. Table 4 lists the 12 engagement clusters and the engagements that they represent.

This is not meant to imply that the engagements represented by any given cluster are identical. Appendix A indicates some of the obvious differences among engagements, in terms of number and mix of threat weapon systems. Engagements also differ with respect to the configuration of the threat systems on the ground, that is, the formation and deployment for different missions and unit types. What is claimed is that the engagements that are clustered together do not differ with respect to the mix of individual and crew tactical gunnery skills required. Although the gunnery subtask may be more or less difficult against different threat targets or larger numbers of threat targets, nonetheless the same set of subtasks will be required. Thus, by presenting any of the engagements grouped under a given cluster, we will know with some certainty that particular subtasks will occur.

Table G-1 of Appendix G presents a matrix showing the individual and crew subtasks that are required by the engagement matrix. Within the matrix, a "2" indicates that the subtask will occur in the context of each engagement in the cluster, and an entry of "-" indicates that the subtask will not occur. Other cell entries refer to the various conditions or enhancements that must be imposed on the engagements, in order to elicit the subtask; the required conditions are identified in the legend of the table, and are described in Table 5.

Without any such modifications, 30 of the 72 individual and crew subtasks would not occur. A summary of the requirements for modifications and the coverage of subtasks by engagements is presented in Table 6.

Table 4

Engagement Clusters with Common Skill Requirements

Engagement Clusters[a]	Engagement			
	Red/Blue Mission	Range	Red Loss Rate	Targets
Defense Distant	1.0 Attack/Defense	3000m	-	40
	2.0 Meeting Engagement/Defense	3000m	-	21
Defense Long	1.1 Attack/Defense	2000m	High	33
	1.4 Attack/Defense	2000m	Low	37
	2.1 Meeting Engagement/Defense	2000m	High	17
	2.4 Meeting Engagement/Defense	2000m	Low	20
Defense Medium	1.2 Attack/Defense	1000m	High	25
	1.5 Attack/Defense	1000m	Low	34
	2.2 Meeting Engagement/Defense	1000m	High	13
	2.5 Meeting Engagement/Defense	1000m	Low	18
Defense Short	1.3 Attack/Defense	400m	High	20
	1.6 Attack/Defense	400m	Low	32
	2.3 Meeting Engagement/Defense	400m	High	10
	2.6 Meeting Engagement/Defense	400m	Low	17
Offense Distant	3.0 Meeting Engagement/Attack	3000m	-	16
	4.0 Defense/Attack	3000m	-	16
	5.0 Withdrawal/Attack	3000m	-	5
Offense Long	3.1 Meeting Engagement/Attack	2000m	High	13
	3.4 Meeting Engagement/Attack	2000m	Low	15
	4.1 Defense/Attack	2000m	High	14
	4.4 Defense/Attack	2000m	Low	15
	5.1 Withdrawal/Attack	2000m	High	4
	5.4 Withdrawal/Attack	2000m	Low	5
Offense Medium	3.2 Meeting Engagement/Attack	1000m	High	10
	3.5 Meeting Engagement/Attack	1000m	Low	14
	4.2 Defense/Attack	1000m	High	10
	4.5 Defense/Attack	1000m	Low	14
	5.2 Withdrawal/Attack	1000m	High	3
	5.5 Withdrawal/Attack	1000m	Low	5
Offense Short	3.3 Meeting Engagement/Attack	400m	High	8
	3.6 Meeting Engagement/Attack	400m	Low	13
	4.3 Defense/Attack	400m	High	8
	4.6 Defense/Attack	400m	Low	13
	5.3 Withdrawal/Attack	400m	High	2
	5.6 Withdrawal/Attack	400m	Low	4
Defense/Breakthrough Zero	6.0 Breakthrough/Defense	0m	-	15
Defense/Breaktnrough Short	6.1 Breakthrough/Defense	400m	High	13
	6.4 Breakthrough/Defense	400m	Low	15
Defense/Breakthrough Medium	6.2 Breakthrough/Defense	1000m	High	11
	6.5 Breakthrough/Defense	1000m	Low	14
Defense/Breakthrough Long	6.3 Breakthrough/Defense	2000m	High	7
	6.6 Breakthrough/Defense	2000m	Low	12

[a]Cluster titles refer to Blue posture (Defensive, Offensive, and Defensive against Red breakthrough) and interforce range (Distant, Long, Medium, Short, and Zero).

Platoon collective subtasks by engagement. Requirements for platoon collective subtasks within the engagements were also identified. Morrison et al. (1990), in their analysis of the matrix, found the platoon subtasks to be more highly associated with individual engagements than were the individual and crew tasks. They suggest that threat-based conditions such as force ratio and Blue mission affect platoon tactical movements and firing techniques much more than they affect individual and crew subtasks such as acquiring or engaging targets. The consistent patterns of engagements and subtask requirements found for individual and crew tasks was simply not replicated for the platoon collective subtasks. However, by liberal applications of footnotes to explain anomalies and exceptions, it was possible to describe platoon task requirements for the same cluster of engagements shown in Table 4. This is a compromise that will allow integration of the selection of engagements to support testing of individual, crew and platoon level skills. The platoon subtasks identified for each engagement cluster are presented in Table G-2 of Appendix G.

As may be seen in Table G-2, occurrence many of the platoon collective subtasks cannot be guaranteed simply by specifying the engagement conditions as laid out by Doyle (1990). Only 9 of the 19 subtasks are sure to occur, without some sort of further constraint on the conditions. A summary of the requirements for engagement modifications is shown in Table 6. In most cases, the extra condition is that the Team Leader, in his OPORD or FRAGO, specify explicitly that the subtask is to occur. In some cases, the specific arrangement of targets on the ground will require the subtask to be performed. Without the induced conditions on the testing, the subtasks may still be performed. But for testing purposes, we need to ensure that certain events will happen, in order that we may be sure of the opportunity to evaluate performance.

As was discussed for the individual and crew subtasks, no claim is made that the engagements within a cluster are identical. In fact, it should be apparent from the notes to Table G-2 that engagements are not even very close to identical with respect to the platoon collective subtasks, a claim that was made in the case of the individual and crew subtasks. But the patterns of subtask requirement are sufficiently consistent that the collapsed matrix was retained as a useable representation of platoon collective subtask requirements.

Method for Selecting Engagements for Testing

The goal of the method for selecting threat-based engagements for testing is to provide maximum coverage of subtasks with best conditions that can be supported. It is captured in a simple series of decision points and procedural steps. The decisions must be made by the test developer, and will be based on the availability of simulator devices or other means for portraying the engagement modifications, the desirability of introducing increasingly artificial constraints on the testing, and the relative importance of the individual/crew and platoon collective subtasks. Tradeoffs must be made: As more tasks are designated to be tested, more simulation in the testing will be required. The process is not, in most cases, strictly linear, in that the decisions and steps will affect and be affected by other decisions and steps.

Table 5

Description of Engagement Modifications

Code	Title	Description
A	Tactical air combat	2 ground attack fighters (Su-25/FROGFOOT), stay on station for 12 minutes, make two passes to deliver ordnance.
B	Attack helicopter	4 attack helicopters (HIND-D), pop up at 1500-2000 meters, exposed 11-25 seconds to deliver AT guided missiles.
D	Chemical environment	VX (nerve) agent contamination of area.
E	Obstacles	Antitank ditch, 75 meters long x 3 meters wide x 1 meter deep, reinforced with antitank mines, antipersonnel mines, and barbed wire.
F	Enemy indirect fire	15 minutes preparation fire, coverage of about 4000 square meters; each 1000 square meters receives 400 rounds HE; continues until interforce distance is about 1000 meters.
G	Smoke/obscuration	Heavy concentration HC smoke, visibility less than 400 meters, covers area 2500 meters x 1000 meters.
N	Night	Night engagements.
S	Special target array	Columnar target or target placement on terrain such that frontal fires cannot be used.
M	System malfunction	Including fire control system (LRF malfunction, symbology loss, crosswind sensor failure, cant sensor failure, LAS failure, day channel failure, TIS failure, stab failure, turret power failure) and weapon systems (main gun, cal .50, COAX, or loader's M240).
3	Three-man crew	One crewmember injured/killed; three remaining crewmembers serve as driver, loader, and gunner/TC.
T	Tank Commander command	TC, PL/PSG, or Team Leader must be coached to give the appropriate command to cause subtask to occur; environmental conditions and threat activities will not guarantee occurrence of subtask.
L	Platoon Leader/ Platoon SGT command	
X	Team Leader command	

Table 6

Summary of Individual, Crew, and Platoon Subtask Coverage by Engagement Clusters

	Engagement Clusters											
	Defense				Offense				Defense/Breakthrough			
Number of Individual and Crew Subtasks	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
Subtasks Covered	8	23	27	34	14	29	35	39	35	36	36	34
Subtasks Not Covered	54	21	14	4	50	20	15	3	7	4	3	4
Subtasks Covered with Modified Conditions	9	27	30	33	7	22	21	29	29	31	32	33
Modifications[a]:												
Tactical air combat (A)	1	1	1	1	1	1	1	1	1	1	1	1
Enemy attack helicopter (B)	3	3	3	1	1	1	1	1	1	1	1	1
Chemical environment (D)	1	1	1	1	1	1	1	1	1	1	1	1
Enemy indirect fire (F)	1	1	1	1	1	1	1	1	1	1	1	1
Smoke/obscuration (G)	-	-	2	2	-	-	-	1	1	1	1	2
Night (N)	-	-	1	1	-	-	-	1	1	1	1	1
System malfunction (M)	3	11	13	14	3	11	10	13	13	13	13	14
Three-man crew (3)	-	5	5	8	-	5	5	3	8	8	8	8
TC command (T)	-	2	2	3	-	2	2	3	3	3	3	3
PL/PSG command (L)	2	5	5	5	2	2	2	2	2	4	5	5
Number of Platoon Collective Subtasks												
Subtasks Covered	1	6	5	4	-	5	5	5	4	4	4	4
Subtasks Not Covered	16	3	3	4	12	6	6	8	10	4	4	4
Subtasks Covered with Modified Conditions	2	10	11	11	7	8	8	6	5	11	11	11
Modifications[a]:												
Tactical air combat (A)	1	1	1	1	1	1	1	1	1	1	1	1
Enemy attack helicopter (B)	1	1	1	1	1	1	1	1	1	1	1	1
Obstacle (E)	1	2	2	2	1	1	1	1	1	2	2	2
Special target array (S)	-	2	2	2	-	2	2	2	2	2	2	2
Team Leader command (X)	-	5	6	6	5	4	4	2	1	6	6	6

[a]Numbers in these cells do not add up to the number shown for the previous line (Number of subtasks covered with modified conditions) because some subtasks may be caused to occur by more than one modification. Letters in parentheses indicate the modification code shown in Table 5.

The subtask by engagement cluster matrixes from Tables G-1 and G-2 have been combined into one composite matrix, presented as Table 7. This matrix is the information source for selection of threat-based engagements. The cell entries, as in Tables G-1 and G-2, indicate that the subtasks will or will not be required by the engagement ("2" or "-" respectively), or that a modification to the engagements will be required in order for the subtask to occur. In cases where exceptions to the pattern occurred, the cell entries indicate the highest rating given in that cell for the engagements in that cluster. Here, "higher" refers to possibility for testing; thus "2" is the highest rating, any modifications are next, and "-" is lowest. The notes to the table indicate the lower rated exceptions to the pattern. We choose to present highest ratings so that the user will readily recognize where opportunities for testing the subtask exist.

Examination of the Subtask by Engagement Cluster Matrix (Table 7) reveals that engagement cluster Defense Distant does not add any unique subtask coverage over clusters Defense Long, Medium, and Short, but that the latter three clusters do contain unique subtask coverage (e.g., consider individual/crew subtasks 3.2, Issue battlesight fire command; 4.4.1, Observe round; 6.1.1.1, Toggle range; and platoon collective subtasks 3.0, Bound by section; and 8.2, Employ alternating fires). Likewise, engagement cluster Offense Distant is completely subsumed under Offense Long, Medium, and Short, all three of which are needed. And engagement clusters Defense/Breakthrough Zero, Short, and Long are all subsumed under Defense/Breakthrough Medium. These modest amounts of redundancy among engagement clusters permit the user some flexibility in selecting varying sets of engagements which will nonetheless require a wide variety of subtasks to be performed.

Morrison et al. (1990) concluded that the threat-based conditions have a larger effect on determining which platoon collective subtasks (as opposed to individual/crew tasks) can be trained. Similarly, here, the exact set of engagements selected will determine which platoon collective subtasks may be tested to a much greater degree than it will determine which individual and crew subtasks will occur. This is because most of the platoon collective subtasks cannot be expected, with high confidence, to occur in many of the engagements, and even then the engagement conditions may require modification. It follows, therefore, that the user should focus first on the platoon collective subtasks of interest in selecting threat conditions, and then consider the individual and crew subtasks.

The decisions that the user must make, at least tentatively, before any selection can be made, and the steps that should be taken on the basis of those decisions, are shown in Table 8. Despite its formidable appearance, the process is simple, requiring the user to return frequently to earlier decisions and selections, adjust them, and repeat the subsequent steps. By so doing, the engagements finally selected comprise the smallest reasonable set that can be supported in testing and that will provide the greatest coverage of the gunnery tactical subtasks for individuals, crews, and platoons.

Table 7

Individual, Crew, and Platoon Subtask by Engagement Cluster Matrix

Individual and Crew Subtasks	Engagement Cluster											
	Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
2. Acquire Target												
2.1. Search/detect												
2.1.1. Choose sight	2	2	2	2	2	2	2	2	2	2	2	2
2.1.2. Daylight sight	2	2	2	2	2	2	2	2	2	2	2	2
2.1.3. Thermal sight	2	2	NG	NG	2	2	2	NG	NG	NG	NG	NG
2.1.4. Search closed-hatch	DF	DF	DF	DF	DF	DF	DF	DF	DF	DF	DF	DF
2.1.5. Search open-hatch	2	2	2	2	2	2	2	2	2	2	2	2
2.2. Locate/ID target	-	2	2	2	-	2	2	2	2	2	2	2
2.3.1. Estimate range visually	-	M	M	M	-	M	M	M	M	M	M	M
3. Issue Fire Command												
3.1. Standard fire command												
3.1.1. Issue std fire command	-	2	2	2	-	2	2	2	2	2	2	2
3.1.2. Lay main gun for direction	-	2	2	2	-	2	2	2	2	2	2	2
3.1.3.1. Spec. dir. verbal	-	M	M	M	-	M	M	M	M	M	M	M
3.1.4. Specify range	-	M	M	M	-	M	M	M	M	M	M	M
3.2. Issue battlesight	-	-	GM	GM	-	-	2a	2b	2	2	2	GM
3.3. Specify multiple target	-	2	2	2	-	2	2	2	2	2	2	2
3.4. Specify simultaneous	-	-	2	2	-	-	2	2	2	2	2	-
4. Engage Single Main Gun Target												
4.1. Fire main gun												
4.1.1. Set FCS switches	-	2	2	2	-	2	2	2	2	2	2	2
4.1.2. ID target	-	2	2	2	-	2	2	2	2	2	2	2
4.1.3. Track	-	2	2	2	-	2	2	2	2	2	2	2
4.1.4. Lase	-	2	2	2	-	2	2	2	2	2	2	2
4.1.5. Fire	-	2	2	2	-	2	2	2	2	2	2	2
4.2. Maneuver												
4.2.1. Direct tank movement	-	2	2	2	-	2	2	2	2	2	2	2
4.2.2. Clear terrain mask	2	2	2	2	2	2	2	2	2	2	2	2
4.2.3. Maintain platform	-	-	-	-	-	2	2	2	2	2	2	2
4.2.4. Use cover and concealment	2	2	2	2	2	2	2	2	2	2	2	2
4.3. Load round	-	2	2	2	2	2	2	2	2	2	2	2
4.4. Observe												
4.4.1. Observe round	-	2	-	-	-	2	-	-	-	-	-	-
4.4.2. Observe effect	-	2	2	2	-	2	2	2	2	2	2	2
5. Engage [Single] COAX Target Precision												
5.1. Engage target												
5.1.1. Engage point	-	-	-	2	-	-	-	2	2	2	2	2
5.1.2. Engage area	-	-	-	2	-	-	-	2	2	2	2	2
5.2. Monitor ammo	-	-	-	2	-	-	-	2	2	2	2	2
6. Engage [Single] Target Degraded												
6.1. Choose technique												
6.1.1. Manually index range												
6.1.1.1. Toggle range	-	M	M	-	-	M	-	-	-	-	-	-
6.1.1.2. Enter CCP	-	M	M	-	-	M	-	-	-	-	-	-
6.1.2. Choose sight	M	M	M	M	M	M	M	M	M	M	M	M
6.1.3. Apply range in GAS	-	M	M	M	-	M	M	M	M	M	M	M
6.1.4. Lead moving target	-	M	M	M	-	M	M	M	M	M	M	M
6.1.5. Use manual controls	M	M	M	M	M	M	M	M	M	M	M	M
6.2. Use multiple return strategy	M	M	M	M	M	M	M	M	M	M	M	M

(table continues)

(Table 7 continued)

Individual and Crew Subtasks	Engagement Cluster: Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
7. TC Engage [Single] Target												
7.1. Engage main gun												
7.1.1. Set switches	-	3	3	3	-	3	3	3	3	3	3	3
7.1.2. Track target	-	3	3	3	-	3	3	3	3	3	3	3
7.1.3. Lase	-	3	3	3	-	3	3	3	3	3	3	3
7.1.4. Fire	-	3	3	3	-	3	3	3	3	3	3	3
7.2. Engage COAX												
7.2.1. Point target	-	-	-	3	-	-	-	3	3	3	3	3
7.2.2. Area target	-	-	-	3	-	-	-	3	3	3	3	3
7.3. Engage Cal .50												
7.3.1. Apply range	-	-	2	2	-	-	2	2	2	2	2	2
7.3.2. Lead	-	-	2	2	-	-	2	2	2	2	2	2
7.3.3. Engage:												
7.3.3.1. Point target	-	-	2	2	-	-	2	2	2	2	2	2
7.3.3.2. Area target	-	-	2	2	-	-	2	2	2	2	2	2
8. LDR Engage [Single] Target												
8.2. Engage area target	-	-	-	T	-	-	-	T	T	T	T	T
8.3. Engage aerial target	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB
9. Engage Multiple Targets												
9.1. Engage main gun/COAX sequential												
9.1.1. Gunner's station												
9.1.1.1. Main gun	-	2	2	2	-	2	2	2	2	2	2	2
9.1.1.2. COAX	-	-	-	2	-	-	-	2	2	2	2	2
9.1.2. TC position												
9.1.2.1. Main gun	-	3	3	3	-	3	3	3	3	3	3	3
9.1.2.2. COAX	-	-	-	3	-	-	-	3	3	3	3	3
9.2. Engage Simultaneous Targets												
9.2.1. Main gun/cal .50	-	-	2	2	-	-	2	2	2	2	2	2
9.2.2. COAX/cal .50	-	-	-	2	-	-	-	2	2	2	2	2
10. Adjust Fire												
10.2. Give subsequent cmd (TC)	-	T	T	T	-	T	T	T	T	T	T	T
10.3. Employ adjustment (GNR)	-	T	T	T	-	T	T	T	T	T	T	T
11. Take Immediate Action												
11.1. Main gun misfire	-	M	M	M	-	M	M	M	M	M	M	M
11.2. COAX failure	-	-	-	M	-	-	-	M	M	M	M	M
11.3. Runaway COAX	-	-	-	M	-	-	-	M	M	M	M	M
11.4. Cal .50	-	-	M	M	-	-	M	M	M	M	M	M
11.5. Loader's M240	-	-	-	M	-	-	-	M	M	M	M	M
12. Employ Smoke												
12.1. Grenades	B	B	B	2	2	2	2	2	2	2	2	2
12.2. Exhaust	B	B	B	2	2	2	2	2	2	2	2	2
13. Report												
13.1. TC Report	2	2	2	2	2	2	2	2	2	2	2	2
13.2. PL/PSG Reports	2	2	2	2	2	2	2	2	2	2	2	2
14. Issue Platoon Fire Command	-	2	2	2	-	2	2	2	2	2	2	2
15. Request Indirect Fire												
15.1. Initiate	L	L	L	L	L	L	L	L	L	L	L	L
15.2. Lift/shift	L	L	L	L	Lc	Ld	Le	L	L	L	L	L
16. PLT Movement												
16.1. Technique	-	Lf	L	L	2	2	2	2	-	L	L	L
16.2. Formation	-	Lf	L	L	2	2	2	2	-	-	L	L
16.3. Direction	-	Lf	L	L	2	2	2	2	-	L	L	L

(table continues)

(Table 7 continued)

Platoon Collective Subtasks	Engagement Cluster: Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
1. Travel in PLT Formation												
1.1. Wedge	-	Xf	X	X	X	Xg	Xh	-	-	X	X	X
1.2. Echelon	-	Xf	X	X	X	Xg	Xh	-	-	X	X	X
1.3. Line	-	Xf	X	X	X1	2j	2k	2	-	X	X	X
1.4. Vee	-	Xf	X	X	X	X	X	X	-	X	X	X
1.5. Column/Staggered column	-	Ef	E	E	-	-	-	-	-	E	E	E
2. Execute Battle Drills												
2.1. Action drill	-	-	-	-	-	2	2	2	-	-	-	-
2.2. Contact drill	-	-	-	-	-	2	2	2	-	-	-	-
2.3. Air attack drill	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB
3. Bound by Section	-	-	X	X	X	X	X	-	-	X	X	X
4. Overwatch Bounding PLT	E	E	E	E	E	E	E	E	E	E	E	E
5. Occupy BP												
5.1. Initial	2	2	2	2	-	-	-	-	2	2	2	2
5.2. Subsequent	-	X	X	X	-	-	-	-	X	X	X	X
6. Maneuver within BP	-	2	2	2	-	-	-	-	2	2	2	2
7. Employ Fire Pattern												
7.1. Frontal	-	2	2	2	-	2	2	2	2	2	2	2
7.2. Cross	-	S	S	S	-	Sd	Se	S1	S	S	S	S
7.3. Depth	-	S	S	S	-	Sd	Se	S1	S	S	S	S
8. Employ Firing Technique												
8.1. Observed	-	2	2	-	-	-	-	-	-	-	-	-
8.2. Alternating	-	2	-	-	-	-	-	-	-	-	-	-
8.3. Simultaneous	-	2	2	2	-	2	2	2	2	2	2	2

Note. Cell entries indicate whether the subtask is covered by engagements in the cluster. See Table 4 for engagement descriptions.

Symbol	Meaning
-	Subtask will not occur during engagements in cluster
2	Subtask will occur during engagements in cluster
Other:	Subtask will occur, given engagement modifications, or will occur under different conditions for engagements in cluster:
3	Three-man crew
A	Tactical air combat
B	Enemy attack helicopter
D	Chemical environment
E	Obstacles
F	Enemy indirect fire
G	Smoke/obscuration
L	Platoon Leader/Platoon SGT command
M	System malfunction
N	Night
S	Special target array
T	Tank Commander command
X	Team Leader/Company Commander command
a	GM for engagements 4.2, 4.5, 5.2, and 5.5
b	GM for engagements 4.3, 4.6, 5.3, and 5.6
c	"-" for engagement 4.0
d	"-" for engagements 4.1 and 4.4
e	"-" for engagements 4.2 and 4.5
f	"-" for engagements 2.1 and 2.4
g	"-" for engagements 4.1, 4.4, 5.1, and 5.4
h	"-" for engagements 4.2, 4.5, 5.2, and 5.5
i	"-" for engagement 5.0
j	X for engagements 3.1 and 3.4
k	X for engagements 3.2 and 3.5
l	"-" for engagements 4.3 and 4.6

The selection procedure begins with the four decisions to be made by the test developer:

1. Are there any engagements or modifications that cannot be supported? Are there any additional constraints on engagement implementation?

2. Are there any subtasks that are not to be tested?

3. Is firing necessary for all engagements?

4. What is the maximum number of engagements to be tested?

Consideration of these very pragmatic issues focuses attention on testing that can and should be developed. Without such front end analysis, tests may be designed that cannot be implemented; resources may be expended evaluating performance inappropriately. For example, if testing is to be conducted on a conduct of fire trainer (COFT), then it is unlikely that loader or driver tasks would be tested, and platoon collective performance would be tested only if the platoon COFT were used. The decisions may be made on the basis of resource allocations, device availability, fidelity goals, or assessment level (crew vs. platoon).

As indicated by Steps 1a, 1b, 1c and 1d, decisions concerning the modifications to be supported and the subtasks to be assessed will result in changes throughout the subtask by engagement cluster matrix. The enhancements provide the initiating cues and reactive feedback that are required in order for subtasks to be elicited with a reasonable degree of realism. For some subtasks, if engagements cannot be modified as specified, then the subtask will only occur under the most artificial conditions. In other cases, if subtasks are designated as not to be tested, then the need for certain of the engagement modifications evaporates.

Once the matrix is cleaned up, based on the first two decisions, the procedure attends to the platoon collective subtasks. As Steps 2, 3, and 4 are performed, the subtasks that are covered by the fewest engagement clusters are of primary importance. Engagements to cover those subtasks are first identified, then other engagements are also located to provide coverage to the remaining platoon subtasks. In general, one or two engagement selections will be sufficient to cover all of the platoon subtasks, even if most of the engagement modifications are not supportable (in which case, of course, the number of subtasks that can be tested has decreased).

Step 5 then directs attention to the individual and crew subtasks, in order to discover which, if any, of those subtasks are not yet covered by the selected engagement cluster(s). Because most of the individual and crew subtasks will occur in a number of engagements, it is usually a simple process to discover one or two additional engagement clusters that will provide the necessary coverage.

Table 8

Summary of Decision Method

Decision 1: Are there any engagements or modifications that cannot be supported? (Or are there any that someone has decided will not be used?) Are there any additional constraints on engagement implementation?

Decision 2: Of the individual and crew subtasks and the platoon collective subtasks, are there any that are not to be tested?

Decision 3: Is firing necessary for all engagements?

Decision 4: What is the maximum number of engagements that can be supported during testing?

Step 1a: If any modifications or engagements cannot (or will not) be supported, convert the cell entries to "-" in the Subtask by Engagement Cluster Matrix.

Step 1b: Likewise, if any subtasks are designated as not to be tested, line out the subtasks in the Subtask by Engagement Cluster Matrix.

Step 1c: If firing is required for every engagement, line out clusters Defense Distant and Offense Distant.

Step 1d: If deletion of any modifications (Step 1a) results in any subtasks now being required by no engagement clusters, line out those subtasks. (If this result is unacceptable, Decision 1 must be reconsidered.)

Step 2: Look first at the platoon collective subtasks in the revised Subtask by Engagement Cluster Matrix. Read across the row for each subtask, and note or highlight any subtasks which occur under only one engagement cluster. Tentatively select all of those engagement clusters which present the only opportunity for one or more subtasks.

Step 3: Still looking at the platoon portion of the matrix, read down the columns for the engagement clusters selected in Step 2. Note or highlight any subtasks that are not included under any of the selected engagement clusters.

(table continues)

(Table 8 continued)

Step 4: Still looking at the platoon portion of the matrix, read across the row for subtasks not yet covered by selected engagement clusters, and tentatively select clusters to cover those subtasks. Select the smallest number of clusters to cover the remaining subtasks. Highlight or make a note of places where an engagement cluster that is selected to cover a subtask has a note on the cell entry; the note will indicate the engagements within the cluster that do not provide subtask coverage.

Step 5: Look at the individual and crew subtask portion of the matrix. Note which subtasks are already covered by the engagement clusters selected in Steps 2, 3, and 4. Then repeat Steps 2, 3 and 4 for individual and crew subtasks. Note: If there are individual/crew subtasks that can only be tested under one engagement cluster, not already selected, check back to the platoon portion of the matrix. See whether or not that cluster can be selected instead of one selected at Step 4, so that the individual/crew subtask and the platoon subtasks can be tested without increasing the number of engagements.

Step 6: If there is some limit to the number of engagements that can be supported, then pause when that limit is reached (Steps 2 - 5). Note which subtasks are not yet covered by the engagements already selected. To test those subtasks, either increase the number of engagements, or substitute other engagements for those already selected, in order to cover the remaining subtasks. If the limit is greater than the number already selected (Steps 2-5), then select additional engagement clusters to provide more coverage of the most critical subtasks, or plan on selecting more than one engagement from selected clusters (in Step 9).

Step 7: Once a set of engagement clusters has been selected, refer to Table 4, the list of engagements grouped under clusters. Find the engagements for the selected clusters. If, in Step 4, you noted that particular engagements within clusters are needed in order to cover specific subtasks, note the particular engagement(s) needed on the table.

Step 8: If any of the engagements include requirements that cannot be supported, eliminate those engagements. (If whole engagement clusters that had been selected are thus eliminated, backtrack through Steps 2 - 6 to find alternate engagement clusters.)

Step 9: Finally, from each selected engagement cluster, select one engagement (of those remaining) for testing.

Step 6 requires that thought be given to a maximum number of engagements. Depending on that maximum, it may be necessary to rethink which subtasks are to be tested, or it may be possible to oversample, thus providing more opportunities to test some subtasks or to test them under different conditions. Note that if the maximum number of engagements desired is greater than the number required for subtask coverage, that maximum can be reached by selecting additional engagements from the designated engagement clusters, rather than by selecting additional clusters.

The final three steps in the procedure turn to consideration of the engagements within the engagement clusters. In using the Subtask by Engagement Clusters matrix, certain of the selected engagement clusters may have included restricting notes; that is, only some of the engagements in the cluster would cover a particular subtask. Now, in looking at the engagements themselves (Table 4), it is important to refer to those notes, in order to avoid selecting engagements that in fact do not require subtask performance. Decision 1 compels consideration of the constraints on implementing any of the engagements. If, for example, targets cannot be placed at ranges of over 2000 meters, or if a limited number of targets can be presented, then the choice of engagements is restricted.

In using this method, the broadest case would be the situation where all subtasks are critical for testing, all modifications can and will be supported, there is no limit on the number of engagements, and there are no constraints on the number and type of threat targets. By selecting clusters Defense Long and either Offense Long or Offense Medium, all of the platoon collective subtasks are covered. By choosing Offense Medium rather than Offense Long, it (together with Defense Long) covers all but 12 of the individual/crew subtasks. Those remaining subtasks can be picked up by selecting from Defense Short, Offense Short or any of the Defense/Breakthrough clusters. The modifications required would include special target arrangements (S), team leader direction (X), obstacles (E), enemy attack helicopters (B or AB), chemical environment or enemy indirect fire (DF), induced malfunctions (M) to the fire control system and weapons (main gun misfire, COAX, loader's M240, and cal .50), three man crew (3), tank commander direction (T), and platoon leader direction (L). Notes to the matrix restrict the choices: From engagement cluster Defense Long, the two Meeting Engagement/Defense engagements are not eligible; and from cluster Offense Medium, the four Defense/Attack and Withdrawal/Attack engagements are not eligible. Still, the few remaining choices (Attack/Defense, Meeting Engagement/Attack and any of the Defense or Offense Short engagements or the Defense/Breakthrough engagements) provide threat arrays at different ranges, in both attack (including breakthrough) and defensive postures, with the Blue force also in attack or defensive postures, and with from 7 to 37 targets each. But the liberal use of enhancements and imposed conditions may be unacceptable, if realism is desired and available training media (simulator devices) are of insufficiently high fidelity.

Appendix H provides an example for using the decision method. The example assumes constraints on imposing additional conditions on the engagements, based on real considerations of availability of resources.

Summary

The validity of interpretation of performance test results is dependent on two factors: (1) the degree to which the test conditions represent actual performance conditions, and (2) the degree to which the test reliably measures the performance domain of interest. Realism in testing and coverage of required performance elements were addressed for the domain of tactical gunnery for individuals, crews, and platoons.

The domain of threat-based engagement conditions was defined by the methodology of Campbell and Campbell (1990), and subsequently employed by Doyle (1990) to develop a set of 42 representative threat engagements. Work by Morrison et al. (1990) not only delineated the individual, crew and platoon collective subtasks required for tactical gunnery, but also linked those subtasks to the Doyle engagements.

This section of the report has analyzed the matrix that portrayed the subtask by engagement linkage, and consequently collapsed the engagements into 12 engagement clusters, each comprising 2 to 6 engagements. Subtask by engagement cluster linkage was explicated to specify the modifications or enhancements to threat engagements that would be required in order for certain of the subtasks to occur.

A decision method was then provided to aid in selecting engagements that would provide subtask coverage for testing purposes. The method requires the user to decide the subtasks that are to be tested, the engagements and modifications that can be supported, whether or not firing is to occur in every engagement, and the number of engagements to be presented during testing. The decisions and steps in the method are demonstrated by means of an example in Appendix H.

Chapter 4: Discussion

The two parts of this report have addressed related issues: training and testing. Both have considered coverage of tactical gunnery activities (tasks or subtasks) by individual crewmembers, tank crews, and platoons. And both have sought to maximize coverage by means of realistic threat conditions that elicit the performances of interest. In consideration of training, interest was focused on maximizing the practice opportunities for poorly performed and highly critical tasks. For testing purposes, our concern is simply to be certain that the subtasks will occur.

The two methodologies share more than a domain sample of threat conditions, however. Neither method can be implemented by a naive user. Extensive input and considerable expert judgment are required to plan and implement the required engagement conditions.

The input, for the training algorithm, includes judgments concerning the relative METL-based importance of the tasks and the current proficiency of the platoon on each task. If these judgments are made without careful thought, use of the algorithm will result in training recommendations that focus resources on areas of lower need. Likewise, in using the testing decision method, it is necessary to determine which of the subtasks are to be evaluated. If careful thought is not given to the subtasks of greatest interest, then those subtasks will not be as reliably measured as possible.

For both uses of the threat domain samples, knowledge of the training/testing facility is paramount. Experts who are familiar with the media to be used must decide which of the engagements and engagement modifications can be supported. For use of the training algorithm, the engagement set must be adjusted before the algorithm is used, because of its sequential and cumulative nature; if it is discovered later that the selected engagements cannot be supported, then, unless other engagements in the same clusters can be substituted, the algorithm must be repeated with corrected engagements information. For the testing method, the decision concerning engagements and engagement modifications that can be supported should be made early in the process simply to avoid having to adjust the selection. If feasibility is never considered, however, the resulting test conditions will likely not be capable of implementation.

In considering engagement implementation feasibility, the user will find it necessary to refer to Doyle (1990). There the engagements are both described and depicted with diagrams. A sample of one such narrative and pictorial presentation of an engagement is included at Figures 3 and 4.

Whether the training or testing are to be presented by means of live fire ranges, free play exercises with fully equipped tanks, or with the use of any gunnery simulators, there are limitations that are beyond what is presented in the engagement descriptions or in the engagement matrixes. For example, some tasks and subtasks require activities on the part of the driver; some simulators do not permit driver participation. Some scenarios require engagement of targets on all sides of the platoon; some range safety fans will not permit these engagements.

Threat Unit:	Motorized Rifle Company (Reinforced) (minus one platoon), as the Forward Security Element of the Advance Guard
Range Line:	Line 1: 2000 meters
Loss Rate:	High - 4 systems (4 system cumulative)
Threat Composition:	3 T-80 tanks 4 BMP-2 Armored Infantry combat vehicles with AT-5, 30mm automatic gun, carrying rifle squads of 7 troops and one RPG-14 each 1 BMP-2 with AT-5, carrying weapons squad of 7 troops with 2 AGS-17 automatic grenade launchers 1 BMP-2 with AT-5, command vehicle 6 2S1 122mm SP howitzers 2 BMP-1974, Artillery command/control vehicles

Threat Disposition at 2000 meters (see Figure 4):

The Motorized Rifle Company (reinforced) has deployed from a pre-battle formation to an attack formation. The attack formation is led by the tanks on line, followed by the two motorized rifle platoons, also on line.

The artillery has established an OP 400 meters to the rear of the main body. The artillery battery remains in its original location, now 1800 meters behind the main body.

Figure 3. Engagement 2.1: Red Meeting Engagement vs. Blue Defense at Long Range, with High Red Loss Rate (from Doyle, 1990).

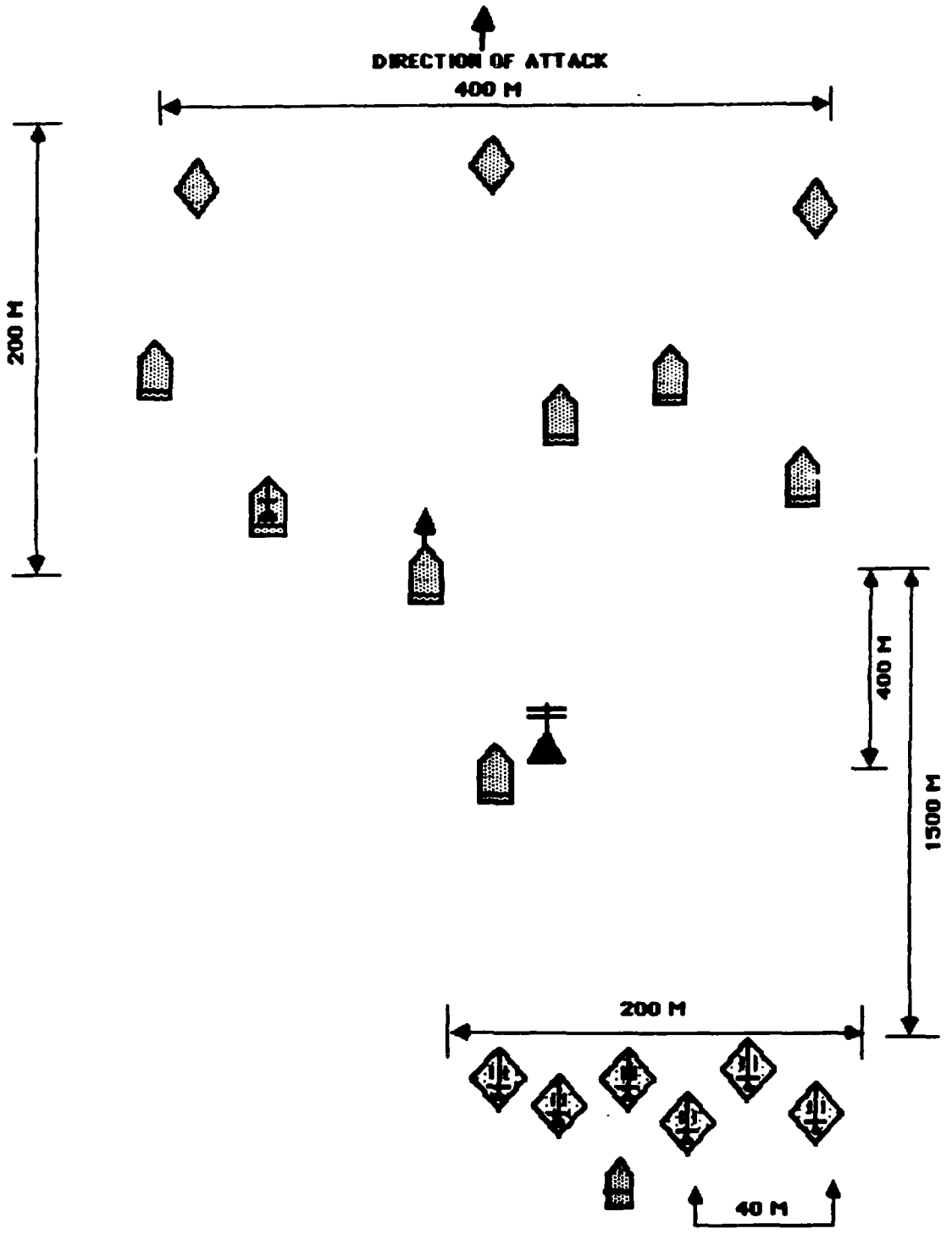

Figure 4. Red Meeting Engagement vs. Blue Defense (motorized rifle company (reinforced) (minus one platoon) as the forward security element of the advance guard), at Long Range, with High Red Loss Rate (from Doyle, 1990).

Particularly for the testing method, it is also necessary to develop the engagement situations to reflect any required modifications. For example, a specific TC command is required in order to ensure that the loader engages area targets with his M240. The TC must therefore be instructed to provide that command. If degraded mode gunnery is to be tested, then the conditions requiring it must be induced. There is nothing in the matrix that will tell the test designer how to induce those conditions.

The two methods, which separately address training and testing needs, differ radically in their philosophy from traditional approaches. The training model builds on theories of skill acquisition, but focusses on selection of training conditions, rather than on selection of tasks. Likewise, the approach to testing is by means of test conditions or performance stimuli, rather than through straightforward but artificial performance on demand. Rather than focussing on tasks, and then reproducing conditions to provide training or testing opportunities, the methods attend to the interaction between conditions and performance. They recognize explicitly that performance is an important issue only because performance defeats the threat.

In conclusion, what this report presents is two general methods for approaching training and testing design. The user is not relieved of responsibility for using experience and intelligence in implementing the methods. The algorithm and the decision method should be regarded as tools which will assist the developer in ensuring that realistic threat conditions form the training/testing context for tactical gunnery, and that the tactical gunnery tasks/subtasks of primary importance receive the necessary attention.

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Appendix A

Table A-1

Summary of Threat Engagements

Red/Blue Mission	Engagement Number	Range	Loss Rate	Threat Targets[a] T-80	BMP-2	2S1	BMP-M1974	BTR-50PK	IMR-2	Cluster
Attack/Defense	1.0	3000	None	12	28					1
	1.1	2000	High	10	23					2
	1.2	1000	High	8	17					6
	1.3	400	High	7	13					3
	1.4	2000	Low	10	27					2
	1.5	1000	Low	9	25					6
	1.6	400	Low	8	24					3
Meeting Engagement/ Defense	2.0	3000	None	4	9	6	2			1
	2.1	2000	High	3	6	6	2			2
	2.2	1000	High	3	5	4	1			6
	2.3	400	High	2	3	4	1			3
	2.4	2000	Low	3	9	6	2			2
	2.5	1000	Low	3	9	5	1			6
	2.6	400	Low	2	9	5	1			3
Meeting Engagement/Attack	3.0	3000	None	4	12					15
	3.1	2000	High	3	10					8
	3.2	1000	High	2	8					10
	3.3	400	High	2	6					11
	3.4	2000	Low	3	12					8
	3.5	1000	Low	3	11					9
	3.6	400	Low	3	10					12
Defense/Attack	4.0	3000	None	4	12					7
	4.1	2000	High	4	10					9
	4.2	1000	High	2	8					10
	4.3	400	High	2	6					11
	4.4	2000	Low	4	11					9
	4.5	1000	Low	4	10					9
	4.6	400	Low	3	10					12
Withdrawal/Attack	5.0	3000	None	1	4					7
	5.1	2000	High	1	3					9
	5.2	1000	High	1	2					10
	5.3	400	High	1	1					11
	5.4	2000	Low	1	4					9
	5.5	1000	Low	1	4					9
	5.6	400	Low	1	3					12
Breakthrough/Defense	6.0	0	None	10	3			1	1	14
	6.1	400	High	9	2			1	1	5
	6.2	1000	High	7	2			1	1	4
	6.3	2000	High	3	2			1	1	4
	6.4	400	Low	10	3			1	1	5
	6.5	1000	Low	9	3			1	1	4
	6.6	2000	Low	8	2			1	1	4
Scenario Enhancements	7.1	TACAIR Frogfoot								
	7.2	Attack Helicopter								
	7.3	Electronic Warfare								
	7.4	NBC								
	7.5	Obstacles								
	7.6	Indirect Fire								
	7.7	Smoke								

Note. Adapted from Doyle (1990).

[a]T-80 = Main Battle Tank, BMP-2 = Armored Infantry Combat Vehicle, 2S1 = 122mm Howitzer, BMP-M1974 = Artillery Command/Control Vehicle, BTR-50PK = Mine Clearer, IMR-2 = Armored Engineer Tractor.

Appendix B

Armor Tasks for Gunnery

Table B-1

Armor Tasks Required by All of the Threat Engagements

Task Title	Task Number
Platoon Tasks	
Perform Precombat Checks	17-3-0102
Employ Command & Control Measures	17-3-0105
Conduct a Hasty Occupation of a Battle Position	17-3-0227
Employ Camouflage & Counter-surveillance Measures	17-3-0301
Take Passive Air Defense Measures	44-3-C001
Crew Tasks	
Move into a Vehicle Fighting Position	2510
Conduct Main Gun Misfire Procedures on an M1/M1A1/M60A3 Tank	5590
Engage Targets with the Main Gun from an M1/M1A1 Tank	5622
React to Anti-Tank Guided Missile	5895
Skill Level 4	
Establish Platoon Battle Positions	071-123-1010
Issue a Platoon Fragmentary Order	071-326-5502
Assign Fields of Fire	171-123-1030
Prepare Platoon Fire Plan	171-123-4001
Direct Platoon Fires	171-123-4004
Skill Level 3	
Conduct Troop Leading Procedures for Operation	071-326-3049
Engage Targets With the M240 COAX from the CWS	171-122-1014
Engage Targets with M240 COAX in CWS Mount	171-122-3007
Engage Targets with the CAL .50 M2HB on M1/M1A1	171-122-3008
Fire M250 Grenade Launcher on M1/M1A1 Tank	171-126-1028
Engage Targets With Main Gun From CWS	171-126-3004
Prepare TC's Weapon for Travel on M1/M1A1 Tank	171-126-3008
Direct Machine Gun Engagements on M1/M1A1 Tank	171-126-3009
Direct Main Gun Engagements on M1/M1A1 Tank	171-126-3010

Table B-2

Armor Tasks Required by Some of the Threat Engagements

Task Title	Task Number
Platoon Tasks	
Respond to a Chemical Agent Attack	03-3-C015
Employ Electronic Counter-Countermeasures	17-3-0103
Execute a Wedge Formation	17-3-0205
Execute a Vee Formation	17-3-0206
Execute a Line Formation	17-3-0207
Execute an Echelon Formation	17-3-0208
Execute Traveling	17-3-0209
Execute Traveling Overwatch	17-3-0210
Execute Bounding Overwatch	17-3-0211
Perform Platoon Fire and Movement	17-3-0217
Perform Reconnaissance by Fire	17-3-0218
Perform an Attack by Fire	17-3-0219
Assault an Enemy Position	17-3-0220
Execute Actions on Contact	17-3-0221
Occupy a Platoon Battle Position	17-3-0222
Displace to a Subsequent Platoon Battle Position	17-3-0223
React to an Enemy Dismounted Attack	17-3-0224
Execute a Platoon Defensive Mission	17-3-0225
Take Actions at an Obstacle	17-3-0401
Respond to Residual Effects of a Nuclear Attack	17-3-0409
Take Active Air Defense Measures	44-3-C002
Change Formation Drill	BD 1
Action Drill	BD 2
Contact Drill	BD 3
Air Attack Drill	BD 4
Indirect Fire Drill	BD 5
Crew Tasks	
Engage Targets from a Sketch Range Card on an M1/M1A1 Tank	5560
Engage Multiple Machine Gun Targets from an M1/M1A1 Tank	5585
React to Indirect Fire (Crew)	5893
Skill Level 4 Tasks	
Conduct a Hasty Assault Breach of a Minefield	051-192-4046
Organize Platoon for Night Defense	071-326-5515
Coordinate With Adjacent Platoon-size Elements	071-326-5775
Direct Platoon Fires in Defense	071-326-5780
Control Techniques of Movement	171-121-3009
Skill Level 3 Tasks	
Implement MOPP	031-503-3008
Select Firing Positions	171-123-1002

Table B-3

Armor Tasks Required by None of the Threat Engagements

Task Title	Task Number
Platoon Tasks	
Prepare for a Chemical Attack	03-3-C011
Prepare for a Nuclear Attack	03-3-C012
Cross a Radiologically Contaminated Area	03-3-C013
Perform Chemical Decontamination	03-3-C016
Prepare for a Friendly Nuclear Strike	03-3-C018
Cross a Chemically Contaminated Area	03-3-C034
Prepare/Evacuate Casualties	08-3-C019
Perform Field Sanitation Operations	08-3-C023
Perform Consolidation & Reorganization Activities	12-2-C021
Perform Tactical Planning	17-3-0100
Prepare for Tactical Operations	17-3-0101
Produce a Platoon Fire Plan	17-3-0104
Perform Assembly Area Activities	17-3-0200
Execute a Coil Formation	17-3-0201
Execute a Herringbone Formation	17-3-0202
Execute a Staggered Column Formation	17-3-0203
Conduct a Tactical Road March	17-3-0212
Move in a Built-up Area	17-3-0213
Assist a Passage of Lines	17-3-0214
Perform a Passages of Lines	17-3-0215
Conduct Rehearsals for a Missions	17-3-0216
Assist a Relief in Place	17-3-0226
Establish an Observational Post	17-3-0302
Execute a Prepared Obstacle	17-3-0402
Construct a Hasty Obstacle	17-3-0403
Emplace a Hasty Protective Minefield	17-3-0404
Respond to Initial Effects of a Nuclear Attack	17-3-0408
Conduct Chemical Reconnaissance	17-3-0412
Perform Resupply Operations	17-3-0601
Perform Maintenance Operations	17-3-0603
Process Enemy Prisoners of War	19-3-C004
Process Captured Documents and Equipment	19-3-C005

(table continues)

(Table B-3 continued)

Task Title	Task Number
Crew Tasks	
Employ OPSEC Measures	1080
Navigate a Tracked Vehicle Cross-Country	2160
Prepare a Vehicle Fighting Position	2500
Emplace a Hasty Minefield	2710
Remove a Hasty Minefield	2730
Recover a Vehicle (Self-Recovery)	5160
Destroy Unit Vehicles and Equipment	5230
Prepare a Tracked Vehicle for a Nuclear Attack	5260
Prepare a Tracked Vehicle for a Chemical Attack	5265
Fuel an M1/M1A1 Tank	5500
Conduct Pre-Combat Checks on an M1/M1A1 Tank	5515
Conduct Before-Ops Checks & Services on M1A1 NBC System	5517
Prepare an M1/M1A1 Tank for Power Pack Removal	5519
Extract an Injured Crewman from an M1/M1A1 Tank	5520
Rearm an M1A1 Tank in an NBC Environment	5521
Extinguish Fires on an M1/M1A1 Tank	5540
Conduct Pre/Post-Fire Checks on an M1/M1A1 Tank	5580
Boresight an M1/M1A1 Tank	5690
Conduct Live a Fire Screening Test on an M1/M1A1/M60A3 Tank	5701
Install a Thrown Track on an M1/M1A1 Tank	5710
Install/Remove Track Blocks on an M1/M1A1 Tank	5720
Recover a Vehicle by Similar Vehicle	5730
Start an M1/M1A1 Tank Using Slave Cables	5740
Tow an M1/M1A1 Tank	5750
Ford a Water Obstacle with an M1/M1A1 Tank	5755
Prepare Gnr's and Ldr's Station for Travel on an M1/M1A1	5761
Conduct Operator Maintenance on 120MM Gun	5775
Troubleshoot the M1/M1A1 Tank Electrical System	5780
Troubleshoot the Fire Control System on an M1/M1A1 Tank	5800
Test the Fire Control System on an M/M1A1 Tank	5801
Decontaminate a Tracked Vehicle	5840
Skill Level 4 Tasks	
Plan/Supervise Positioning M8 Alarm	031-503-4002
Collect/Report Total Radiation Dose	031-503-4003
Mark Position of Friendly Ground Units	071-326-0519
Conduct a Tactical Road March	071-326-3013
Consolidate/Reorganize Plt-Size Elmnt Aft Contact (Defense)	071-326-5511
Prepare/Issue an Oral Operations Order	071-326-5626
Supervise Platoon Maintenance	171-123-1018
Supervise Assembly Area Activities	171-123-4003
Coordinate Passage of Lines	171-123-4007
Direct Consolidation & Reorganization on the Objective	171-123-4008

(table continues)

(Table B-3 continued)

Task Title	Task Number
Skill Level 3 Tasks	
Lead MOPP Gear Exchange	031-503-2009
Initiate Unmasking Procedures	031-503-3002
Supervise Crossing a Contaminated Area	031-503-3004
Prepare/Submit NBC-1 Reports	031-503-3005
Conduct Hasty Decontamination	031-503-3006
Supervise Radiation Monitoring	031-503-4006
Direct Minefield Making Party	051-192-2026
Direct Installation/Removal of Hasty Protective Minefield	051-192-3032
Determine Line-of-Sight Limitations Using a Terrain Profile	051-203-4513
Prepare/Submit a Shell/Mortar/Bomb Report	061-306-6005
Consolidate/Reorganize Sqd-Size Elmnt Aft Contact (Defense)	071-326-5510
Supervise Preparation of Sqd-size Elmnt Defensive Position	071-326-5701
Establish an Observation Post	071-326-5705
Designate Fighting Positions for Squad Members	071-326-5710
Direct Sqd-size Element Fires in Defense	071-326-5725
Conduct Passage of Lines	071-326-5811
Supervise Maintenance on Individual & TO&E Equipment	071-328-5302
Determine Elevation Using Map	071-329-1004
Convert Azimuth (Magnetic or Grid)	071-329-1009
Locate Unknown Point on Map or Ground Using Intersection	071-329-1014
Locate Unknown Point on Map or Ground Using Resection	071-329-1015
Determine Azimuth with Protractor & Compute Back Azimuth	071-329-1031
Analyze Terrain Using 5 Military Aspects of Terrain	071-331-0820
Prepare/Operate COMSEC Equipment TSEC/KY-57	113-609-2013
Construct Field Expedient Antennas	171-121-1009
Supervise Personnel Handling Ammunition	171-123-3001
Install/Remove M240 COAX in CWS of the M1/M1A1 Tank	171-122-3006
Install/Remove M2HB Machine Gun on M1/M1A1	171-122-3009
Zero CAL .50 M2HB Machine Gun on M1/M1A1	171-122-3010
Boresight M2HB on M1/M1A1	171-122-3011
Inspect DA Form 2408 (Wpns Rec Data) for Accuracy	171-123-3002
Establish Silent Watch from M1/M1A1 Tank	171-126-3001
Prepare CWS for Operation on M1/M1A1 Tank	171-126-3002
Secure CWS on M1/M1A1 Tank	171-126-3003
Perform TC's Preparation-to-Fire PMCS on M1/M1A1 Tank	171-126-3005
Perform TC's After Firing PMCS on M1/M1A1 Tank	171-126-3007

Appendix C

Task Practice Opportunities for Each Threat Engagement

Table C-1

Task Practice Matrix for Motorized Rifle Regiment Analysis

Defensive engagements

Task Number	Task Title	Engagement Number																					
		1.0	1.1	1.2	1.3	1.4	1.5	1.6	2.0	2.1	2.2	2.3	2.4	2.5	2.6	6.0	6.1	6.2	6.3	6.4	6.5	6.6
Platoon Tasks:																						
17-3-0222	OCCUPY A PLATOON BATTLE POSITION	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0
17-3-0225	EXECUTE A PLATOON DEFENSIVE MISSION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0227	CONDUCT HASTY OCCUPATION OF A BATTLE POSITION	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0209	EXECUTE TRAVELING	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
17-3-0207	EXECUTE A LINE FORMATION	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	1	1	1	1	1	1
17-3-0208	EXECUTE A ECHELON FORMATION	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	1	1	1	1	1	1
17-3-0210	EXECUTE TRAVELING OVERWATCH	0	1	1	0	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0
17-3-0211	EXECUTE BOUNDING OVERWATCH	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0223	DISPLACE TO A SUBSEQUENT BATTLE POSITION	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0224	REACT TO AN ENEMY DISMOUNTED ATTACK	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	1	0	1	1
Crew Tasks:																						
5560	ENGAGE TARGETS FROM A SKETCH RANGE CARD ON A M1/M1A1 TANK	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
5585	ENGAGE MULTIPLE MACHINE GUN TARGETS	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Skill Level 4 Tasks:																						
071-326-5515	ORGANIZE PLATOON FOR NIGHT DEFENSE	1	1	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
071-326-5775	COORDINATE WITH ADJACENT PLATOON-SIZED ELEMENTS	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	1	1	1	1	1
071-326-5780	DIRECT PLATOON FIRES IN THE DEFENSE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
171-121-3009	CONTROL TECHNIQUES OF MOVEMENT	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Skill Level 3 Tasks:																						
171-123-1002	SELECT FIRING POSITIONS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

(table continues)

(Table C-1 continued)

Offensive engagements

Task Number	Task Title	Engagement Number																				
		3.0	3.1	3.2	3.3	3.4	3.5	3.6	4.0	4.1	4.2	4.3	4.4	4.5	4.6	5.0	5.1	5.2	5.3	5.4	5.5	5.6
Platoon Tasks:																						
17-3-0227	CONDUCT HASTY OCCUPATION OF A BATTLE POSITION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0209	EXECUTE TRAVELING	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0205	EXECUTE A WEDGE FORMATION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0206	EXECUTE A VEE FORMATION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0207	EXECUTE A LINE FORMATION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0208	EXECUTE A ECHELON FORMATION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0210	EXECUTE TRAVELING OVERWATCH	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
17-3-0211	EXECUTE BOUNDING OVERWATCH	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0217	PERFORM PLATOON FIRE AND MOVEMENT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0221	EXECUTE ACTIONS ON CONTACT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BTL DR 1	CHANGE FORMATION DRILL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BTL DR 3	CONTACT DRILL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17-3-0218	PERFORM RECONNAISSANCE BY FIRE	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
17-3-0219	PERFORM AN ATTACK BY FIRE	0	0	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	0
17-3-0220	ASSAULT AN ENEMY POSITION	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1
BTL DR 2	ACTION DRILL	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	1	0	1	1
Crew Tasks:																						
5585	ENGAGE MULTIPLE MACHINE GUN TARGETS	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1
Skill Level 4 Tasks:																						
171-121-3009	CONTROL TECHNIQUES OF MOVEMENT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
071-326-5775	COORDINATE WITH ADJACENT PLATOON-SIZE ELEMENT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Skill Level 3 Tasks:																						
171-123-1002	SELECT FIRING POSITIONS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

(table continues)

(Table C-1 continued)

Engagement enhancements

Task Number	Task Title	Engagement Number 7.1	7.2a	7.2b	7.3	7.4a	7.4b	7.5	7.6	7.7	Remarks
Platoon Tasks:											
44-3-C002	TAKE ACTIVE AIR DEFENSE MEASURES	1	1	1	0	1	0	0	0	0	
BTL DR 4	AIR ATTACK DRILL	1	1	1	0	1	0	0	0	0	
17-3-0103	EMPLOY ECCM	0	0	0	1	0	0	0	0	0	Note 2
03-3-C015	RESPOND TO A CHEMICAL AGENT ATTACK	0	0	0	0	1	1	0	1	1	Note 3
17-3-0409	RESPOND TO RESIDUAL EFFECTS OF A NUCLEAR ATTACK	0	0	0	0	0	1	0	0	0	Note 3
17-3-0401	TAKE ACTIONS AT AN OBSTACLE	0	0	0	0	0	0	1	0	0	
BTL DR 5	INDIRECT FIRE DRILL	0	0	0	0	0	0	0	1	1	Note 4
Crew Tasks:											
5585	ENGAGE MULTIPLE MACHINE GUN TARGETS	1	0	0	0	0	0	0	0	0	
5893	REACT TO INDIRECT FIRE	0	0	0	0	0	1	0	1	1	
5560	ENGAGE TARGETS FROM A SKETCH RANGE CARD ON AN M1/M1A1 TANK	0	0	0	0	0	0	0	0	1	Note 5
Skill Level 4 Tasks:											
051-192-4046	CONDUCT A HASTY ASSAULT BREACH OF A MINEFIELD	0	0	0	0	0	0	1	0	0	
Skill Level 3 Tasks:											
031-503-3008	IMPLEMENT MOPP	1	0	0	0	0	1	0	0	0	

Notes.

1. "1" indicates that the task can be practiced in the engagement enhancement. "0" indicates that the task is not performed in the engagement enhancement. Tasks with all 0's are not listed.

2. Reaction to enemy EW is dependent upon EW condition--whether intermittent or jamming or deceptive transmissions are portrayed.

3. Collective and individual tasks appropriate to engagement enhancement 7.4a and 7.4b are dependent on type of attack (nuclear or chemical, persistent or non-persistent).

4. Engagement enhancement 7.7 applicable only if smoke is artillery-delivered.

5. Task appropriate only in Blue prepared defensive situation.

Appendix D

Guide to Programs for Engagement Selection

The programming for selecting engagements for training or testing comprises three related programs, written in BASIC for MS-DOS.

On the Engagement Selection diskette are the BASIC command files, three program files, and five data files. Complete descriptions of how to use the program and data files are provided below; the program and data files, briefly, are:

TASKENG.MRR	Program files for creating the task and engagement specifications data files.
TASK	Task data files produced by TASKENG program. Used also in PDATASET program.
ENG	Engagement data files produced by TASKENG program. Used also in PDATASET and SELECT program.
PDATASET.MRR	Program file for entering the task-by-engagement practice values and the task learning values.
PDATA	Practice value and learning difficulty value data file produced by the PDATASET program. Used in the SELECT program.
P2DATA, P3DATA	Practice value and difficulty value data files produced for the situationally related sets and force-on-force roll-ups.
SELECT.MRR	Program file for entering the importance and proficiency data for tasks, which are used in selecting engagements.

Using the Programs

In order to use any of the program files, insert the Engagement Selection diskette, make sure that the system default drive refers to the drive with the Engagement Selection diskette, and type "BASIC" and the name of the program. For example, to run the TASKENG program, type:

BASIC TASKENG2.MRR (press **Return**).

Each of the programs is then menu-driven; that is, the user responds to instructions on the screen in order to enter information or request different routines in the program.

TASKENG

The first program, TASKENG, is used to create and revise files containing task descriptions and engagement descriptions.

Task Descriptions. For task descriptions, the user is prompted to enter the following information:

Task reference number: Two digits, which are unique task serial numbers designated by the user.

Task number: Up to 12 digits, representing the Army numbering system for drills, tasks, exercises, etc.

Task title: Up to 35 characters (no commas).

Task type: Platoon, crew, individual Skill Level 3, or individual Skill Level 4.

Before entering tasks, the program will caution that all existing task descriptions will be destroyed; that is, the previously created task file will be scratched. It is recommended that the TASK file be backed up to another disk before experimenting with the TASKENG programs.

These task descriptions are saved in a random access file named TASK. Currently, the TASK file holds 36 tasks. Other task routines in the TASKENG program permit the user to change any or all of the description fields for a selected task, to add and delete tasks and descriptions, and to list the descriptions file on the screen or on the printer.

Engagement Descriptions. The second portion of Program TASKENG is used to create and revise the engagement description file. For engagements, the user is prompted to enter:

Engagement number: Three digits. The first digit is the Reference Initial Scenario number, 1-6, or 7 for Enhancements. The second digit represents Loss Rate (1 = High, 2 = Low); for Initial Scenarios, the second digit is 0; for Enhancements, the second digit is the unique enhancement serial number, 1-9. The third digit indicates the engagement Range Line (1, 2, or 3); for Initial Scenarios and Enhancements, the third digit is 0.

Engagement title: 40 characters. The title describes the Red mission, Blue mission, and either "Initial" or a 2-character designation of Loss Rate (H or L) and Range Line (1, 2, or 3). For Enhancements, the title is the battlefield system represented.

Number of weapons systems or troops: Four fields, representing numbers of tanks, BMPs, troops, and other systems (e.g., howitzers). For Enhancements, only number of systems overall is entered.

Threat formation: Three fields, representing frontage, depth, and range from Blue, in meters. For Enhancements, only range from Blue is entered.

Movement: Red and Blue moving or stationary. Not entered for Enhancements.

Cluster: Two digits, indicating membership in cluster of engagements with similar task requirements.

These engagement descriptions are saved in a random access file named ENG. The information used in creating the 42 MRR threat engagement descriptions and the 9 enhancements was developed by R. Campbell and C. Campbell (in preparation), and complete narrative and graphic descriptions of the engagements and the enhancement scenarios may be found in Doyle (1989).

Again, the program will caution that the currently existing ENG file will be scratched before new files are created. The ENG data file should be backed up to another disk before experimenting with the TASKENG program.

Other engagement routines in the TASKENG program permit the user to change any or all of the description fields for a selected engagement, to add and delete engagements and descriptions, and to list the descriptions file on the screen or on the printer.

PDATASET

Once the task and engagement descriptions are entered using the TASKENG program, the second step is to use the PDATASET program to enter the task-by-engagement practice values and the task learning rates. The program accesses files TASK and ENG to prompt the user for practice values (1 or 0) and learning rates (easy or hard), and records the values in a sequential file named PDATA.

The program then "rolls up" the practice values in two ways, once for sets of situationally related engagements, and once for scenarios. A situationally related engagement set comprises the three engagement scenarios, at three Range Lines, for a given Initial Scenario and Loss Rate. The roll up protocol for situationally related engagement sets records in file P2DATA a task practice value of "1" for a set if any of the engagements in the set has a "1" for that task, and a "0" if all three of the engagements have "0" for the task. (Initial Scenarios are not recorded into the P2DATA file; Enhancements are carried into the P2DATA file with no roll up.)

The roll up for scenarios operates in much the same way, but considers all scenarios from both Loss Rates and all three Range Lines in determining the task practice values. The resulting file, named P3DATA, also includes the Enhancements with no roll up.

If you are going to experiment with this, it is recommended that you back up the PDATA, PDATA2, P2DATA, and P3DATA files first, so as to preserve them.

If any tasks or engagements have been added or dropped from TASK or ENG since the values were last entered into PDATA using the PDATASET program, the program warns the user of the discrepancy and requires the user to enter values as needed or to acquiesce to the deletion of values. The PDATASET

program also permits the user to change values for selected engagements, for selected tasks, or for a selected engagement-task value. Each time the user makes changes to the PDATA file, the program repeats the roll ups to reconstruct P2DATA and P3DATA.

SELECT

The third program, the SELECT program, then uses the information entered using the TASKENG and PDATASET programs, as well as importance and proficiency information entered by the user, to select engagements for training purposes in an order that maximizes opportunities for practice on tasks that are important, that most require practice (current proficiency is low), and that are most quickly learned. The user chooses whether to select from the full set of engagements and enhancements, from among sets of situationally related engagements (defined above), or from force-on-force scenario start points.

SELECT prompts the user for task importance values (1, 2, or 3, where 3 is most important), and for current percent proficiency values (between 10 and 90). The algorithm used to select the engagements is described in the report. It requires considerable time to run, so the program displays a running report of the selection progress.

For each of the three protocols (from all engagements, from sets of situationally related engagement, or from scenarios) the program selects without replacement, and treats enhancements the same as engagements. The output consists of, first, a summary of the task values of learning difficulty, importance, proficiency, and calculated initial levels of experience.

The program then produces a listing of the engagements (or engagement sets or scenarios) and enhancements in the order in which they were selected, along with the descriptions from the ENG file and a running tally of the numbers of tanks, BMPs, troops, and other systems required as targets; if selecting from all engagements, the output also indicates what other engagements, not already selected, are in the same cluster. If selecting from sets of situationally related engagements, all engagements contained in the selected set are printed.

Appendix E

BASIC Program Listings

PROGRAM LISTING: TASKENG.MRR

```
20 LPRINT CHR$(27);CHR$(78);CHR$(6);
40 LPRINT "PROGRAM TASKENG.MRR  TIME: ";TIME$;" DATE: ";DATE$;    'TASKENG.MRR
7/17/89
60 REM  PROGRAM ENTERS TASK DESCRIPTIONS IN RANDOM ACCESS FILE "TASK", AND
80 REM  ENGAGEMENT DESCRIPTIONS IN RANDOM ACCESS FILE "ENG".
100 A$ = ""
120 PRINT CHR$(12):PRINT "THIS PROGRAM HANDLES ENTRY OR READING OF TASK
DESCRIPTIONS,"
140 PRINT "AND ENTRY OR READING OF ENGAGEMENT DESCRIPTIONS AND SPECIFICATIONS"
160 PRINT "FOR MOTORIZED RIFLE REGIMENT ENGAGEMENTS."
180 PRINT:PRINT "WHICH TOPIC DO YOU WANT?":PRINT
200 PRINT 1;"  TASK DESCRIPTIONS -- MRR"
220 PRINT 2;"  ENGAGEMENT DESCRIPTIONS -- MRR"
240 PRINT 3;"  END OF MRR TASK/ENGAGEMENT PROGRAM"
260 PRINT:PRINT "SELECT A TOPIC:  "
280 A$ = INKEY$:IF A$ = "" THEN 280 ELSE TOPIC = VAL(A$)
300 IF (TOPIC < 1) OR (TOPIC > 3) THEN 180
320 ON TOPIC GOSUB 380, 2560
340 IF TOPIC = 3 THEN PRINT:PRINT "END OF TASKENG.MRR": END
360 GOTO 180
380 REM *** BEGIN TASK ROUTINES
400 OPEN "R",#1,"TASK"
420 FIELD #1, 2 AS RT$, 12 AS TT$, 35 AS DT$, 1 AS PT$
440 PRINT CHR$(12):PRINT "CREATE, READ, CHANGE, ADD, OR DELETE MRR TASK
DESCRIPTIONS":PRINT
460 PRINT 1;"  CREATE TASK DESCRIPTION FILE"
480 PRINT 2;"  READ EXISTING TASK DESCRIPTIONS"
500 PRINT 3;"  CHANGE EXISTING TASK DESCRIPTIONS"
520 PRINT 4;"  ADD NEW TASK DESCRIPTIONS"
540 PRINT 5;"  DELETE TASK AND DESCRIPTION"
560 PRINT 6;"  PRINT HARD COPY OF TASK DESCRIPTIONS"
580 PRINT 7;"  END TASK ROUTINES -- RETURN TO MAIN MENU"
600 PRINT:PRINT:PRINT "SELECT A NUMBER: "
620 A2$ = INKEY$: IF A2$ = "" THEN 620 ELSE SEL = VAL(A2$)
640 IF (SEL<1) OR (SEL>7) THEN 440
660 ON SEL GOSUB 740,1160,1380,1600,1740,2260
680 IF SEL=7 THEN CLOSE #1: RETURN
700 GOTO 440
720 STOP
740 REM *** CREATE NEW TASK DESCRIPTION FILE
760 PRINT CHR$(12)
780 PRINT "IF YOU SELECT CREATE, ALL EXISTING TASK DESCRIPTIONS MUST BE
RE-CREATED."
800 PRINT "ARE YOU SURE (Y/N)? "
820 Z$ = INKEY$: IF Z$ = "" THEN 820 ELSE IF Z$ < > "Y" THEN 440
840 CLOSE #1: KILL "TASK"
860 OPEN "R",#1,"TASK"
880 FIELD #1, 2 AS RT$, 12 AS TT$, 35 AS DT$, 1 AS PT$
900 PRINT:INPUT "TASK 2-DIGIT REFERENCE NUMBER (OR 999 TO END) ";REF$
```

PROGRAM LISTING: TASKENG.MRR (Continued)

```
920 IF REF$ = "999" THEN GOTO 1160
940 INPUT "TASK NUMBER ";NUM$
960 INPUT "TASK TITLE ";DESC$
980 INPUT "TYPE (1 = PLATOON, 2 = CREW, 3 = SL3, 4 = SL4) ";TYP$
1000 IF TYP$ <> "" AND TYP$ <> "1" AND TYP$ <> "2" AND TYP$ <> "3" AND TYP$ <>
"4" THEN PRINT "INVALID TASK TYPE.":PRINT:GOTO 980
1020 IF REF$ <> "" THEN LSET RT$ = REF$
1040 IF NUM$ <> "" THEN LSET TT$ = NUM$
1060 IF DESC$ <> "" THEN LSET DT$ = DESC$
1080 IF TYP$ <> "" THEN LSET PT$ = TYP$
1100 ON SEL GOTO 1120,1160,1560,1680,1740,2260
1120 PUT #1
1140 GOTO 900
1160 REM *** LIST TASK DESCRIPTION FILE
1180 LASTREC = LOF(1)/128:X$ = ""
1200 PRINT CHR$(12):PRINT "THERE ARE";LASTREC;"TASKS.":PRINT
1220 PRINT "RECORD REF#  TASK NUMBER      TASK TITLE" TAB(67) "TYPE"
1240 FOR I = 1 TO LASTREC
1260 GET #1, I
1280 PRINT TAB(3) I TAB(9) RT$ TAB(14) TT$ TAB(29) DT$ TAB(69) PT$
1300 NEXT I
1320 PRINT:PRINT "PRESS ANY KEY TO CONTINUE."
1340 X$ = INKEY$: IF X$ = "" THEN 1340 ELSE RETURN
1360 STOP
1380 REM *** CHANGE EXISTING TASK DESCRIPTION
1400 PRINT CHR$(12):INPUT "RECORD NUMBER OF TASK TO CHANGE (OR 999 TO
QUIT)";R%
1420 IF R% = 999 THEN GOTO 1160
1440 GET #1,R%
1460 PRINT "AT PROMPTS, ENTER NEW (CHANGED) NUMBER OR TITLE,"
1480 PRINT "   OR PRESS RETURN TO LEAVE UNCHANGED."
1500 PRINT "CURRENT TASK NUMBER AND DESCRIPTION ARE:":
1520 PRINT:PRINT "RECORD ";R%;" TASK ";RT$;": ";TT$ SPC(2) DT$ "TYPE ";PT$
1540 GOTO 900  'INPUT NEW TASK NUMBER AND/OR TITLE
1560 PUT #1, R%: GOTO 1400
1580 RETURN
1600 REM *** ADD MORE TASK DESCRIPTIONS
1620 NEXTREC% = LOF(1)/128 + 1
1640 PRINT CHR$(12):PRINT "TASKS WILL BE ADDED BEGINNING AT RECORD
NUMBER";NEXTREC%:PRINT
1660 GOTO 900  'INPUT NEW TASK NUMBER AND/OR TITLE
1680 PUT #1, NEXTREC%
1700 GOTO 1620
1720 RETURN
1740 REM *** DELETE TASK AND TASK DESCRIPTION
1760 PRINT CHR$(12)
1780 INPUT "RECORD NUMBER OF TASK TO BE DELETED, OR 999 TO QUIT: ",R%
1800 IF R% = 999 THEN GOTO 1180
1820 GET #1, R%
```

```
1840 PRINT "TASK ";R%;": ";RT$ TAB(17) TT$ TAB(31) DT$:PRINT
1860 PRINT "DELETE TASK (Y/N)?"
1880 X2$ = INKEY$: IF X2$ = "" THEN 1880 ELSE IF X2$ <> "Y" THEN GOTO 1780
1900 LASTREC = LOF(1)/128
1920 OPEN "R", #2, "TASKTEMP"
1940 FIELD #2, 2 AS RA$, 12 AS TA$, 35 AS DA$, 1 AS PA$
1960 J = 0
1980 FOR I = 1 TO LASTREC
2000 GET #1, I
2020 IF I = R% THEN GOTO 2160
2040 LSET RA$ = RT$
2060 LSET TA$ = TT$
2080 LSET DA$ = DT$
2100 LSET PA$ = PT$
2120 J = J + 1
2140 PUT #2,J
2160 NEXT I
2180 CLOSE #1:CLOSE#2:KILL "TASK": NAME "TASKTEMP" AS "TASK"
2200 OPEN "R", #1, "TASK"
2220 FIELD #1, 2 AS RT$, 12 AS TT$, 35 AS DT$, 1 AS PT$
2240 GOTO 1160
2260 REM *** PRINT HARD COPY OF TASK DESCRIPTIONS
2280 LASTREC = LOF(1)/128
2300 LPRINT "MRR TASKS -- ";LASTREC:LPRINT
2320 LPRINT "RECORD REF#  TASK NUMBER      TASK TITLE" TAB(70) "TYPE"
2340 LPRINT STRING$(6,45) SPC(1) STRING$(4,45) SPC(2) STRING$(12,45) SPC(2)
STRING$(35,45) TAB(70) STRING$(4,45):LPRINT
2360 FOR I = 1 TO LASTREC
2380 GET #1, I
2400 IF PT$ = "1" THEN TYP$ = " PLT"
2420 IF PT$ = "2" THEN TYP$ = "CREW"
2440 IF PT$ = "3" THEN TYP$ = "SL 3"
2460 IF PT$ = "4" THEN TYP$ = "SL 4"
2480 LPRINT TAB(3) I TAB(9) RT$ TAB(14) TT$ TAB(29) DT$ TAB(70) TYP$
2500 NEXT I
2520 LPRINT CHR$(12)
2540 RETURN
2560 REM *** BEGIN ENGAGEMENTS ROUTINES
2580 OPEN "R",#1,"ENG"
2600 FIELD #1, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
2620 PRINT CHR$(12):PRINT "CREATE, READ, CHANGE, ADD, OR DELETE MRR ENGAGEMENT
DESCRIPTIONS":PRINT
2640 PRINT 1;"  CREATE ENGAGEMENT DESCRIPTION FILE"
2660 PRINT 2;"  READ EXISTING ENGAGEMENT DESCRIPTIONS"
2680 PRINT 3;"  CHANGE EXISTING ENGAGEMENT DESCRIPTIONS OR SPECIFICATIONS"
2700 PRINT 4;"  ADD NEW ENGAGEMENT DESCRIPTIONS"
2720 PRINT 5;"  DELETE ENGAGEMENT AND DESCRIPTION"
2740 PRINT 6;"  PRINT ENGAGEMENT DESCRIPTIONS"
```

```
2760 PRINT 7;"  END ENGAGEMENT ROUTINES -- RETURN TO MAIN MENU"
2780 PRINT:PRINT:PRINT "SELECT A NUMBER: "
2800 A3$ = INKEY$: IF A3$ = "" THEN 2800 ELSE SEL = VAL(A3$)
2820 IF (SEL<1) OR (SEL>7) THEN GOTO 2620
2840 ON SEL GOSUB 2920,3840,4240,4760,4900,5580
2860 IF SEL = 7 THEN CLOSE #1:RETURN
2880 GOTO 2620
2900 STOP
2920 REM *** CREATE NEW ENGAGEMENT DESCRIPTION FILE
2940 PRINT CHR$(12)
2960 PRINT "IF YOU SELECT CREATE, ALL EXISTING ENGAGEMENT DESCRIPTIONS WILL BE
DELETED."
2980 PRINT "ARE YOU SURE (Y/N)?"
3000 A4$ = INKEY$: IF A4$ = "" THEN 3000 ELSE IF A4$ <> "Y" THEN 2620
3020 CLOSE #1: KILL "ENG"
3040 OPEN "R",#1,"ENG"
3060 FIELD #1, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
3080 PRINT CHR$(12)
3100 PRINT:INPUT "ENGAGEMENT NUMBER (OR 999 TO END)";NUM$
3120 IF NUM$ = "999" THEN GOTO 3840
3140 INPUT "ENGAGEMENT TITLE ";DESC$
3160 IF NUM$ = "" THEN NUM$ = EE$
3180 IF LEFT$(NUM$,1) = "7" THEN GOTO 3480
3200 PRINT "EQUIPMENT:"
3220 INPUT "   NUMBER OF TANKS";TK$
3240 INPUT "   NUMBER OF BMPS ";BP$
3260 INPUT "   NUMBER OF TROOPS";TPS$
3280 INPUT "   NUMBER OF OTHER PIECES";OTH$
3300 PRINT:PRINT "FORMATION AREA:"
3320 INPUT "   FORMATION FRONTAGE IN METERS ";FR$
3340 INPUT "   FORMATION DEPTH IN METERS    ";DP$
3360 INPUT "   RED/BLUE RANGE IN METERS     ";RNG$
3380 PRINT:PRINT "MOVEMENT:"
3400 INPUT "   RED MOVING (MOV) OR STATIONARY (STA)  ";RMOV$
3420 INPUT "   BLUE MOVING (MOV) OR STATIONARY (STA) ";BMOV$
3440 PRINT:INPUT "ENGAGEMENT CLUSTER ";CLUS$
3460 GOTO 3540
3480 INPUT "NUMBER OF SYSTEMS ";OTH$
3500 INPUT "RANGE FROM BLUE ";RNG$
3520 INPUT "CLUSTER ";CLUS$
3540 IF NUM$ <> "" THEN LSET EE$ = NUM$
3560 IF DESC$ <> "" THEN LSET DE$ = DESC$
3580 IF TK$ <> "" THEN RSET TE$ = TK$
3600 IF BP$ <> "" THEN RSET BE$ = BP$
3620 IF TPS$ <> "" THEN RSET PE$ = TPS$
3640 IF OTH$ <> "" THEN RSET OE$ = OTH$
3660 IF FR$ <> "" THEN RSET FE$ = FR$
3680 IF DP$ <> "" THEN RSET LE$ = DP$
```

```
3700 IF RNG$ <> "" THEN RSET RGE$ = RNG$
3720 IF RMOV$ <> "" THEN LSET MRE$ = RMOV$
3740 IF BMOV$ <> "" THEN LSET MBE$ = BMOV$
3760 IF CLUS$ <> "" THEN LSET CE$ = CLUS$
3780 ON SEL GOTO 3800,3840,4720,4840,3840,5580
3800 PUT #1
3820 GOTO 3100
3840 REM *** LIST ENGAGEMENT DESCRIPTION FILE
3860 LASTREC = LOF(1)/128
3880 PRINT CHR$(12):PRINT "THERE ARE";LASTREC;"ENGAGEMENTS.":PRINT
3900 PRINT "RECORD ENG'T ENGAGEMENT DESCRIPTION" TAB(54) "EQUIPMENT
FORMATION"
3920 PRINT STRING$(6,45) TAB(7) STRING$(5,45) TAB(13) STRING$(40,45) TAB(54)
STRING$(9,45) TAB(65) STRING$(15,45)
3940 FOR I = 1 TO LASTREC
3960 GET #1, I
3980 IF LEFT$(EE$,1) <> "7" THEN 4060
4000 PRINT:PRINT TAB(2) I TAB(7) EE$ TAB(13) "ENHANCEMENT: ";
4020 PRINT USING "\                          \";DE$;:PRINT TAB(54) "SYSTEMS ";OE$
TAB(65) "   RANGE";RGE$;"M"
4040 PRINT TAB(13) "CLUSTER ";CE$: GOTO 4160
4060 PRINT:PRINT TAB(2) I TAB(7) EE$ TAB(13) DE$ TAB(55) "TANKS ";TE$ TAB(65)
"FRONTAGE ";FE$;"M"
4080 PRINT TAB(56) "BMPS ";BE$ TAB(65) "   DEPTH ";LE$;"M"
4100 PRINT TAB(13) "CLUSTER ";CE$ TAB(54) "TROOPS";PE$ TAB(65) "
RANGE";RGE$;"M"
4120 PRINT TAB(55) "OTHER ";OE$ TAB(65) " RED ";MRE$
4140 PRINT TAB(65) "BLUE ";MBE$
4160 NEXT I
4180 PRINT:PRINT "PRESS ANY KEY TO CONTINUE."
4200 Y$ = INKEY$: IF Y$ = "" THEN 4200 ELSE RETURN
4220 STOP
4240 REM *** CHANGE EXISTING ENGAGEMENT DESCRIPTION
4260 PRINT CHR$(12):INPUT "RECORD NUMBER OF ENGAGEMENT (OR 999 TO QUIT)";R%
4280 IF R% = 999 THEN GOTO 3840
4300 PRINT:PRINT "AT PROMPTS, TYPE NEW ENGAGEMENT NUMBER, TITLE, AND/OR
SPECIFICATIONS,"
4320 PRINT "  OR PRESS RETURN TO LEAVE UNCHANGED."
4340 PRINT "  CURRENT NUMBER, TITLE, AND SPECIFICATIONS ARE:"
4360 GET #1,R%
4380 PRINT:PRINT "RECORD";R%;":  ENGAGEMENT ";EE$;": ";DE$
4400 IF LEFT$(EE$,1) = "7" THEN 4640
4420 PRINT "      TANKS:  ";TE$
4440 PRINT "       BMPS:  ";BE$
4460 PRINT "     TROOPS: ";PE$
4480 PRINT "      OTHER:  ";OE$
4500 PRINT "   FRONTAGE: ";FE$;" METERS"
4520 PRINT "      DEPTH: ";LE$;" METERS"
4540 PRINT "      RANGE:";RGE$;" METERS"
```

```
4560 PRINT " RED MOV OR STA: ";MRE$
4580 PRINT "BLUE MOV OR STA: ";MBE$
4600 PRINT "CLUSTER: ";CE$
4620 GOTO 4700
4640 PRINT "   SYSTEMS: ";OE$
4660 PRINT "     RANGE: ";RGE$;" METERS"
4680 PRINT "   CLUSTER: ";CE$
4700 GOTO 3100  'INPUT NEW ENGAGEMENT NUMBER, TITLE, AND/OR SPECIFICATIONS
4720 PUT #1, R%: GOTO 4260
4740 RETURN
4760 REM *** ADD MORE ENGAGEMENT DESCRIPTIONS
4780 NEXTREC% = LOF(1)/128 + 1
4800 PRINT CHR$(12):PRINT "NEXT ENGAGEMENT ADDED WILL HAVE RECORD
NUMBER";NEXTREC%:PRINT
4820 GOTO 3100  'INPUT NEW ENGAGEMENT NUMBER, TITLE, AND/OR SPECIFICATIONS
4840 PUT #1, NEXTREC%
4860 GOTO 4780
4880 RETURN
4900 REM *** DELETE ENGAGEMENT AND DESCRIPTION
4920 PRINT CHR$(12)
4940 INPUT "RECORD NUMBER OF ENGAGEMENT TO BE DELETED, OR 999 TO QUIT: ",R%
4960 IF R% = 999 THEN GOTO 3840
4980 GET #1, R%
5000 PRINT "ENGAGEMENT ";EE$ TAB(17) DE$:PRINT
5020 PRINT "DELETE ENGAGEMENT (Y/N)?"
5040 X3$ = INKEY$:IF X3$ = "" THEN 5040 ELSE IF X3$ <> "Y" THEN 4940
5060 LASTREC = LOF(1)/128
5080 OPEN "R", #2, "ENGTEMP"
5100 FIELD #2, 3 AS EB$, 40 AS DB$, 2 AS TB$, 2 AS BB$, 3 AS PB$, 2 AS OB$, 4
AS FB$, 4 AS LB$, 5 AS RGB$, 3 AS MRB$, 3 AS MBB$, 2 AS CB$
5120 J = 0
5140 FOR I = 1 TO LASTREC
5160 GET #1, I
5180 IF I = R% THEN GOTO 5480
5200 LSET EB$ = EE$
5220 LSET DB$ = DE$
5240 RSET TB$ = TE$
5260 RSET BB$ = BE$
5280 RSET PB$ = PE$
5300 RSET OB$ = OE$
5320 RSET FB$ = FE$
5340 RSET LB$ = LE$
5360 RSET RGB$ = RGE$
5380 LSET MRB$ = MRE$
5400 LSET MBB$ = MBE$
5420 LSET CB$ = CE$
5440 J = J + 1
5460 PUT #2, J
5480 NEXT I
```

PROGRAM LISTING: TASKENG.MRR (Continued)

```
5500 CLOSE #1:CLOSE #2: KILL "ENG":NAME "ENGTEMP" AS "ENG"
5520 OPEN "R",#1,"ENG"
5540 FIELD #1, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
5560 GOTO 3840
5580 REM *** PRINT HARD COPY OF ENGAGEMENT SPECIFICATIONS
5600 LASTREC = LOF(1)/128
5620 LPRINT "  MRR ENGAGEMENTS -- ";LASTREC:LPRINT
5640 LPRINT:LPRINT "RECORD ENG'T ENGAGEMENT DESCRIPTION" TAB(54) "EQUIPMENT
FORMATION"
5660 LPRINT STRING$(6,45) TAB(7) STRING$(5,45) TAB(13) STRING$(40,45) TAB(54)
STRING$(9,45) TAB(65) STRING$(15,45)
5680 FOR I = 1 TO LASTREC
5700 GET #1, I
5720 IF MBE$ = "MOV" THEN LET MB1$ = "MOVING"
5740 IF MBE$ = "STA" THEN LET MB1$ = "STATIONARY"
5760 IF MRE$ = "MOV" THEN LET MR1$ = "MOVING"
5780 IF MRE$ = "STA" THEN LET MR1$ = "STATIONARY"
5800 IF LEFT$(EE$,1) <> "7" THEN 5860
5820 LPRINT:LPRINT TAB(2) I TAB(7) EE$ TAB(13) "ENHANCEMENT: ";
5840 LPRINT USING "\                          \";DE$;:LPRINT TAB(53) "SYSTEMS
";OE$ TAB(65) "   RANGE";RGE$;"M":LPRINT TAB(13) "CLUSTER "CE$:GOTO 5960
5860 LPRINT:LPRINT TAB(2) I TAB(7) EE$ TAB(13) DE$ TAB(55) "TANKS ";TE$
TAB(65) "FRONTAGE ";FE$;"M"
5880 LPRINT TAB(56) "BMPS ";BE$ TAB(65) "   DEPTH ";LE$;"M"
5900 LPRINT TAB(13) "CLUSTER ";CE$ TAB(54) "TROOPS";PE$ TAB(65) "
RANGE";RGE$;"M"
5920 LPRINT TAB(55) "OTHER ";OE$ TAB(65) " RED ";MR1$
5940 LPRINT TAB(65) "BLUE ";MB1$
5960 NEXT I
5980 LPRINT CHR$(12)
6000 RETURN
6020 END
```

PROGRAM LISTING: PDATASET.MRR

```
20 WIDTH "LPT1:",132:LPRINT CHR$(27);CHR$(78);CHR$(6);CHR$(15);
40 LPRINT "PROGRAM PDATASET.MRR  TIME: ";TIME$;"  DATE: ";DATE$; '
PDATASET.MRR  7/17/89
60 REM *** BEGIN TASK PRACTICE PER ENGAGEMENT ROUTINES ****************
80 OPTION BASE 1
100 DIM P(55,40), K(40), K$(40), F2%(55), F3%(55), P2(55,40), P3(55,40),
ENG$(55), EN2$(55), EN3$(55), TSK$(40), S2(55), S3(55), DRE$(55), DRT$(40)
120 PRINT CHR$(12):PRINT "ENTER, READ, CHANGE, ADD, DELETE, OR PRINT"
140 PRINT "TASK PRACTICE PER ENGAGEMENT VALUES"
160 PRINT "FOR MOTORIZED RIFLE REGIMENT ENGAGEMENTS.":PRINT
180 PRINT 1;"  ENTER TASK PRACTICE PER ENGAGEMENT VALUES"
200 PRINT 2;"  READ TASK PRACTICE PER ENGAGEMENT VALUES"
220 PRINT 3;"  CHANGE TASK PRACTICE PER ENGAGEMENT VALUES"
240 PRINT 4;"  ADD TASK PRACTICE PER ENGAGEMENT VALUES"
260 PRINT 5;"  PRINT HARD COPY OF TASK PRACTICE PER ENGAGEMENT VALUES"
280 PRINT 6;"  END TASK PRACTICE PER ENGAGEMENT ROUTINES"
300 PRINT:PRINT "SELECT A NUMBER: "
320 A$ = INKEY$:IF A$ = "" THEN 320 ELSE SEL = VAL(A$)
340 IF SEL<1 OR SEL>6 THEN GOTO 180 ELSE IF SEL<>1 AND SEL<>6 AND NOT T THEN
GOSUB 6680
360 ON SEL GOSUB 420, 1360, 5060, 5060, 1360
380 IF SEL = 6 THEN PRINT:PRINT "END OF PROGRAM PDATASET.MRR":END
400 GOTO 120
420 REM *** CREATE PRACTICE PER ENGAGEMENT MATRIX **********************
440 PRINT CHR$(12):PRINT "IF YOU SELECT THIS OPTION, THE EXISTING TASK
PRACTICE PER ENGAGEMENT VALUES "
460 PRINT "WILL BE ERASED, AND ALL VALUES WILL HAVE TO BE ENTERED AGAIN."
480 PRINT:PRINT "IS THAT WHAT YOU WANT TO DO (Y/N)?"
500 C$=INKEY$: IF C$ = "" GOTO 500 ELSE IF C$ = "Y" GOTO 540 ELSE GOTO 120
520 CHNG = 0
540 KILL "PDATA"
560 T = NOT T
580 OPEN "O", #1, "PDATA"
600 OPEN "R",#2,"TASK"
620 FIELD #2, 2 AS RT$, 12 AS TT$, 35 AS DT$, 1 AS PT$
640 CNUM = LOF(2)/128
660 PRINT:PRINT "NUMBER OF TASKS IS ";CNUM:PRINT
680 OPEN "R", #3, "ENG"
700 FIELD #3, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
720 RNUM = LOF(3)/128
740 PRINT "NUMBER OF ENGAGEMENTS IS ";RNUM:PRINT
760 FOR R = 1 TO RNUM
780 PRINT "ENGAGEMENT ";R;"NUMBER ";
800 GET #3, R: ENG$(R) = EE$:PRINT ENG$(R)
820 IF CHNG = 2 THEN 880
840 FOR C = 1 TO CNUM
860 GET #2, C: TSK$(C) = RT$
880 PRINT TAB(5) "TASK ";TSK$(C);
```

PROGRAM LISTING: PDATASET.MRR (Continued)

```
900 INPUT ": VALUE = ",P(R,C)
920 IF P(R,C) < > 1 AND P(R,C) < > 0 THEN PRINT:PRINT "MUST BE 0 (ZERO) OR 1
(ONE).":GOTO 880
940 IF CHNG = 2 THEN 1000
960 NEXT C
980 IF CHNG = 1 THEN RETURN
1000 NEXT R
1020 IF CHNG = 2 THEN RETURN
1040 PRINT:PRINT "LEARNING RATES, E = EASY, H = HARD"
1060 FOR C = 1 TO CNUM
1080 GET #2, C: TSK$(C) = RT$
1100 PRINT "TASK ";TSK$(C);
1120 INPUT K$(C)
1140 IF K$(C) <> "E" AND K$(C) <> "H" THEN PRINT:PRINT "MUST BE E (EASY) OR H
(HARD)."::PRINT:GOTO 1100
1160 IF K$(C) = "H" THEN K(C) = 1.3 ELSE IF K$(C) = "E" THEN K(C) = .5 ELSE
K(C) = ""
1180 NEXT C
1200 IF CHNG = 4 THEN RETURN
1220 WRITE#1, RNUM, CNUM
1240 FOR R = 1 TO RNUM
1260 WRITE#1, ENG$(R)
1280 FOR C = 1 TO CNUM
1300 WRITE#1, TSK$(C), P(R,C), K(C)
1320 NEXT C:NEXT R
1340 CLOSE #1:CLOSE #2:CLOSE #3
1360 REM *** BEGIN ROLL-UPS**************************************
1380 IF ZE = 0 AND ZT = 0 AND SEL <> 3 AND SEL <> 4 THEN 2920
1400 PRINT:PRINT:PRINT "CALCULATING PRACTICE VALUES FOR SITUATIONALLY RELATED
SETS AND"
1420 PRINT "FOR FORCE-ON-FORCE SCENARIOS...":PRINT
1440 OPEN "O", #1, "P2DATA":CLOSE #1
1460 OPEN "O", #1, "P3DATA":CLOSE #1
1480 KILL "P2DATA":KILL "P3DATA"
1500 OPEN "I", #1, "PDATA"
1520 INPUT#1, RNUM, CNUM
1540 FOR R = 1 TO RNUM
1560 INPUT#1, ENG$(R)
1580 FOR C = 1 TO CNUM
1600 INPUT#1, TSK$(C), P(R,C), K(C)
1620 NEXT C
1640 F2%(R) = 0:F3%(R) = 0
1660 NEXT R
1680 CLOSE #1
1700 REM *** BEGIN SITUATIONAL ROLL-UP ************************
1720 LET K = 1
1740 FOR R = 1 TO RNUM
1760 IF F2%(R) <> 0 THEN GOTO 2020
1780 LET L = K:LET S2(L) = 1
```

PROGRAM LISTING: PDATASET.MRR (Continued)

```
1800 LET EN2$(L) = LEFT$(ENG$(R),2): F2%(R) = 1
1820 FOR C = 1 TO CNUM
1840 LET P2(L,C) = P(R,C)
1860 NEXT C
1880 FOR J = R+1 TO RNUM
1900 IF F2%(J) <> 0 THEN GOTO 2000
1920 IF EN2$(L) <> LEFT$(ENG$(J),2) THEN GOTO 2000 ELSE F2%(J) = 1:S2(L) =
S2(L)+1
1940 FOR C = 1 TO CNUM
1960 IF P(J,C) = 1 OR P2(L,C) = 1 THEN P2(L,C) = 1
1980 NEXT C
2000 NEXT J:K=L+1
2020 NEXT R
2040 M = 0
2060 FOR J = 1 TO L
2080 F2%(J) = 0
2100 IF RIGHT$(EN2$(J),1) <> "0" THEN 2140
2120 F2%(J) = 1: M = M + 1
2140 NEXT J
2160 L = L - M
2180 OPEN "O", #1, "P2DATA"
2200 WRITE#1, L, CNUM
2220 FOR R = 1 TO L + M
2240 IF F2%(R) = 1 THEN 2340
2260 WRITE#1, EN2$(R),S2(R)
2280 FOR C = 1 TO CNUM
2300 WRITE#1, TSK$(C), P2(R,C), K(C)
2320 NEXT C
2340 NEXT R
2360 CLOSE #1
2380 REM *** BEGIN FORCE-ON-FORCE ROLL-UP **************************
2400 LET K = 1
2420 FOR R = 1 TO RNUM
2440 IF F3%(R) <> 0 THEN GOTO 2740
2460 LET L = K:LET S3(L) = 1
2480 IF LEFT$(ENG$(R),1) = "7" THEN EN3$(L) = LEFT$(ENG$(R),2): F3%(R) = 1:
GOTO 2520
2500 LET EN3$(L) = LEFT$(ENG$(R),1): F3%(R) = 1
2520 FOR C = 1 TO CNUM
2540 LET P3(L,C) = P(R,C)
2560 NEXT C
2580 IF VAL(EN3$(L)) => 70 THEN K = L + 1: GOTO 2740
2600 FOR J = R+1 TO RNUM
2620 IF F3%(J) <> 0 THEN GOTO 2720
2640 IF EN3$(L) <> LEFT$(ENG$(J),1) THEN GOTO 2720 ELSE F3%(J) = 1:S3(L) =
S3(L) + 1
2660 FOR C = 1 TO CNUM
2680 IF P(J,C) = 1 OR P3(L,C) = 1 THEN P3(L,C) = 1
2700 NEXT C
```

```
2720 NEXT J:K = L + 1
2740 NEXT R
2760 OPEN "O", #1, "P3DATA"
2780 WRITE#1, L, CNUM
2800 FOR R = 1 TO L
2820 WRITE#1, EN3$(R),S3(R)
2840 FOR C = 1 TO CNUM
2860 WRITE#1, TSK$(C), P3(R,C), K(C)
2880 NEXT C:NEXT R
2900 CLOSE #1
2920 IF SEL = 5 THEN 8160
2940 REM *** SHOW NUMBER OF TASKS, ENGAGEMENTS, VALUES, LEARNING RATES *****
2960 PRINT:PRINT:PRINT:PRINT "READING IN DATA ...":PRINT
2980 OPEN "I", #1, "PDATA"
3000 INPUT#1, RNUM, CNUM
3020 FOR R = 1 TO RNUM
3040 INPUT#1, ENG$(R)
3060 FOR C = 1 TO CNUM
3080 INPUT#1, TSK$(C), P(R,C), K(C)
3100 IF K(C) = 1.3 THEN K$(C) = "H" ELSE IF K(C) = .5 THEN K$(C) = "E" ELSE
K$(C) = "M"
3120 NEXT C:NEXT R
3140 IX = INT((CNUM * 3)/60) + 1
3160 JY = INT(RNUM/20) + 1
3180 PRINT:PRINT "PRACTICE PER ENGAGEMENT VALUES AND LEARNING RATES"
3200 PRINT:PRINT RNUM;"ENGAGEMENTS,";CNUM;"TASKS"
3220 PRINT:PRINT "ENG'T" TAB(7) "TASK PRACTICE VALUES"
3240 FOR X = 1 TO IX
3260 PRINT TAB(7);
3280 FOR C = 20 * (X - 1) + 1 TO 20 * X
3300 PRINT TSK$(C) SPC(1);
3320 IF C = CNUM THEN 3360
3340 NEXT C
3360 FOR Y = 1 TO JY
3380 FOR R = 20 * (Y - 1) + 1 TO 20 * Y
3400 PRINT:PRINT ENG$(R) TAB(6)
3420 FOR C = 20 * (X - 1) + 1 TO 20 * X
3440 PRINT USING "###";P(R,C);
3460 IF C = CNUM THEN 3500
3480 NEXT C
3500 IF R = RNUM THEN 3540
3520 NEXT R
3540 PRINT:PRINT:PRINT "PRESS ANY KEY TO CONTINUE"
3560 A2$ = INKEY$: IF A2$ = "" THEN 3560 ELSE NEXT Y
3580 PRINT:PRINT:PRINT "LEARNING RATES: ":PRINT TAB(6);
3600 FOR C = 20 * (X - 1) + 1 TO 20 * X
3620 PRINT SPC(2) K$(C);
3640 IF C = CNUM THEN 3680
3660 NEXT C
```

```
3680 PRINT:PRINT:PRINT "PRESS ANY KEY TO CONTINUE"
3700 Z$ = INKEY$: IF Z$ = "" THEN 3700 ELSE  NEXT X
3720 CLOSE #1
3740 REM *** SHOW VALUES FOR SITUATIONAL ROLLUP **********************
3760 OPEN "I", #1, "P2DATA"
3780 INPUT#1, L, CNUM
3800 FOR R = 1 TO L
3820 INPUT#1, EN2$(R),S2(R)
3840 FOR C = 1 TO CNUM
3860 INPUT#1, TSK$(C), P2(R,C), K(C)
3880 NEXT C:NEXT R
3900 IX = INT((CNUM * 3)/60) + 1
3920 JY = INT(L/20) + 1
3940 CLOSE #1
3960 PRINT:PRINT "PRACTICE VALUES FOR SITUATIONALLY RELATED ENGAGEMENTS"
3980 PRINT:PRINT L;"ENGAGEMENT SETS"
4000 PRINT:PRINT "SET" TAB(5) "ENGTS" TAB(11) "TASKS"
4020 FOR X = 1 TO IX
4040 PRINT TAB(11);
4060 FOR C = 20 * (X - 1) + 1 TO 20 * X
4080 PRINT TSK$(C) SPC(1);
4100 IF C = CNUM THEN 4140
4120 NEXT C
4140 FOR Y = 1 TO JY
4160 FOR R = 20 * (Y - 1) + 1 TO 20 * Y
4180 PRINT:PRINT EN2$(R) TAB(5) S2(R) TAB(10);
4200 FOR C = 20 * (X - 1) + 1 TO 20 * X
4220 PRINT USING "###";P2(R,C);
4240 IF C = CNUM THEN 4280
4260 NEXT C
4280 IF R = L THEN 4320
4300 NEXT R
4320 PRINT:PRINT:PRINT "PRESS ANY KEY TO CONTINUE"
4340 A3$ = INKEY$: IF A3$ = "" THEN 4340 ELSE NEXT Y
4360 NEXT X
4380 CLOSE #1
4400 REM *** SHOW VALUES FOR FORCE-ON-FORCE ROLLUP **********************
4420 OPEN "I", #1, "P3DATA"
4440 INPUT#1, L, CNUM
4460 FOR R = 1 TO L
4480 INPUT#1, EN3$(R),S3(R)
4500 FOR C = 1 TO CNUM
4520 INPUT#1, TSK$(C), P3(R,C), K(C)
4540 NEXT C:NEXT R
4560 CLOSE #1
4580 IX = INT((CNUM * 3)/60) + 1
4600 JY = INT(L/20) + 1
4620 PRINT:PRINT "PRACTICE VALUES FOR FORCE-ON-FORCE ENGAGEMENTS"
4640 PRINT:PRINT L;"ENGAGEMENT SCENARIOS"
```

```
4660 PRINT:PRINT "SCEN" TAB(6) "ENGTS" TAB(12) "TASKS"
4680 FOR X = 1 TO IX
4700 PRINT TAB(12);
4720 FOR C = 20 * (X - 1) + 1 TO 20 * X
4740 PRINT TSK$(C) SPC(1);
4760 IF C = CNUM THEN 4800
4780 NEXT C
4800 FOR Y = 1 TO JY
4820 FOR R = 20 * (Y - 1) + 1 TO 20 * Y
4840 PRINT:PRINT EN3$(R) TAB(5) S3(R) TAB(11);
4860 FOR C = 20 * (X - 1) + 1 TO 20 * X
4880 PRINT USING "###";P2(R,C);
4900 IF C = CNUM THEN 4940
4920 NEXT C
4940 IF R = L THEN 4980
4960 NEXT R
4980 PRINT:PRINT:PRINT "PRESS ANY KEY TO CONTINUE"
5000 A3$ = INKEY$: IF A3$ = "" THEN 5000 ELSE NEXT Y
5020 NEXT X
5040 CLOSE #1:RETURN
5060 REM *** CHANGE OR ADD VALUES ************************************
5080 OPEN "I", #1, "PDATA"
5100 INPUT#1, RNUM, CNUM
5120 FOR R = 1 TO RNUM
5140 INPUT#1, ENG$(R)
5160 FOR C = 1 TO CNUM
5180 INPUT#1, TSK$(C), P(R,C), K(C)
5200 NEXT C:NEXT R
5220 OPEN "R", #2, "TASK"
5240 FIELD #2, 2 AS RT$, 12 AS TT$, 35 AS DT$, 1 AS PT$
5260 OPEN "R", #3, "ENG"
5280 FIELD #3, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
5300 PRINT CHR$(12): PRINT "DO YOU WANT TO:"
5320 PRINT:PRINT 1;"  CHANGE OR ADD PRACTICE VALUES FOR AN ENGAGEMENT (ROW)?"
5340 PRINT 2;"  CHANGE OR ADD PRACTICE VALUES FOR A TASK (COLUMN)?"
5360 PRINT 3;"  CHANGE THE PRACTICE VALUE FOR A SELECTED TASK-BY-ENGAGEMENT?"
5380 PRINT 4;"  CHANGE ALL OF THE TASK LEARNING VALUES?"
5400 PRINT 5;"  CHANGE A SELECTED TASK LEARNING VALUE?"
5420 PRINT 6;"  END CHANGES AND RETURN TO MENU?"
5440 PRINT:PRINT:PRINT "SELECT ONE: "
5460 A4$ = INKEY$:IF A4$ = "" THEN 5460 ELSE CHNG = VAL(A4$)
5480 ON CHNG GOSUB 5580,5780,5980,6360,6440
5500 IF CHNG <> 6 THEN GOTO 5300
5520 CLOSE#1
5540 OPEN "O", #1, "PDATA"
5560 GOTO 1220
5580 REM *** CHANGE OR ADD PRACTICE VALUES FOR ENGAGEMENT ***************
```

```
5600 PRINT CHR$(12):INPUT "CHANGE OR ADD PRACTICE VALUES FOR WHAT ENGAGEMENT
(NUMBER)";EC$
5620 FOR R = 1 TO RNUM
5640 IF ENG$(R) <> EC$ THEN 5700
5660 GOSUB 840
5680 RETURN
5700 NEXT R
5720 PRINT:PRINT "ENGAGEMENT ";EC$;" NOT FOUND.";
5740 INPUT "  ENTER ENGAGEMENT NUMBER AGAIN, OR 999 TO QUIT.  ",EC$
5760 IF EC$ = "999" THEN RETURN ELSE 5620
5780 REM *** CHANGE OR ADD VALUES FOR TASK*******************
5800 PRINT CHR$(12):INPUT "CHANGE OR ADD VALUES FOR WHAT TASK (REFERENCE
NUMBER)";RTC$
5820 FOR C = 1 TO CNUM
5840 IF TSK$(C) <> RTC$ THEN 5900
5860 GOSUB 760
5880 RETURN
5900 NEXT C
5920 PRINT:PRINT "TASK ";RTC$;" NOT FOUND.";
5940 INPUT "  ENTER TASK NUMBER AGAIN, OR 999 TO QUIT. ",RTC$
5960 IF RTC$ = "999" THEN RETURN ELSE 5820
5980 REM *** CHANGE OR ADD VALUE FOR ONE TASK X ENGAGEMENT **************
6000 PRINT CHR$(12):INPUT "WHAT ENGAGEMENT (NUMBER)";EC$
6020 PRINT:INPUT "WHAT TASK (REFERENCE NUMBER)";RTC$
6040 FOR R = 1 TO RNUM
6060 IF EC$ <> ENG$(R) THEN 6280
6080 FOR C = 1 TO CNUM
6100 IF RTC$ <> TSK$(C) THEN 6200
6120 PRINT:PRINT "ENGAGEMENT ";ENG$(R);", TASK ";TSK$(C);" VALUE WILL BE
CHANGED FROM ";P(R,C);" TO ";
6140 IF P(R,C) = 0 THEN LET P(R,C) = 1 ELSE LET P(R,C) = 0
6160 PRINT P(R,C):PRINT "PRESS ANY KEY TO CONTINUE"
6180 A7$ = INKEY$: IF A7$ = "" THEN 6180 ELSE RETURN
6200 NEXT C
6220 PRINT:PRINT "TASK ";RTC$;" NOT FOUND.";
6240 INPUT "  ENTER TASK NUMBER AGAIN, OR 999 TO QUIT.  ",RTC$
6260 IF RTC$ = "999" THEN RETURN ELSE 6040
6280 NEXT R
6300 PRINT:PRINT "ENGAGEMENT ";EC$;" NOT FOUND.";
6320 INPUT "  ENTER ENGAGEMENT NUMBER AGAIN, OR 999 TO QUIT.",EC$
6340 IF EC$ = "999" THEN RETURN ELSE 6020
6360 REM *** CHANGE ALL TASKS' LEARNING VALUES***************************
6380 PRINT CHR$(12)
6400 GOSUB 1060
6420 RETURN
6440 REM *** CHANGE LEARNING VALUE FOR SELECTED TASK*********************
6460 PRINT CHR$(12):INPUT "CHANGE OR ADD LEARNING VALUE FOR WHAT TASK
(REFERENCE NUMBER)";RTC$
6480 FOR C = 1 TO CNUM
```

```
6500 IF RTC$ <> TSK$(C) THEN 6600
6520 PRINT:PRINT "TASK ";TSK$(C);" LEARNING VALUE WILL BE CHANGED FROM
";K(C);" TO ";
6540 IF K(C) = 1.3 THEN K(C) = .5 ELSE K(C) = 1.3
6560 PRINT:PRINT K(C):PRINT "PRESS ANY KEY TO CONTINUE"
6580 A8$ = INKEY$: IF A8$ = "" THEN 6580 ELSE RETURN
6600 NEXT C
6620 PRINT:PRINT "TASK ";RTC$;" NOT FOUND.";
6640 INPUT "  ENTER TASK NUMBER AGAIN, OR 999 TO QUIT. ",RTC$
6660 IF RTC$ = "999" THEN RETURN ELSE 6480
6680 REM *** LINK PDATA TO ENGAGEMENT AND TASK FILES, HOUSEKEEPING ********
6700 X = 0: Y = 0: ZT = 0: ZE = 0: T = NOT T: ZEA = 0: ZTA = 0
6720 PRINT:PRINT:PRINT:PRINT "CHECKING FILES FOR CONSISTENCY ...":PRINT
6740 OPEN "I", #1, "PDATA"
6760 INPUT#1, RNUM, CNUM
6780 FOR R = 1 TO RNUM
6800 INPUT#1, ENG$(R)
6820 FOR C = 1 TO CNUM
6840 INPUT#1, TSK$(C), P(R,C), K(C)
6860 NEXT C:NEXT R
6880 OPEN "R", #2, "TASK"
6900 FIELD #2, 2 AS RT$, 12 AS TT$, 35 AS DT$, 1 AS PT$
6920 OPEN "R", #3, "ENG"
6940 FIELD #3, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
6960 CNUM2 = LOF(2)/128
6980 RNUM3 = LOF(3)/128
7000 FOR R = 1 TO RNUM:X = X + 1
7020 GET #3, X
7040 IF ENG$(R) <> EE$ THEN DRE$(R) = "1":X = X - 1:ZE = ZE + 1
7060 NEXT R
7080 FOR Q = X + 1 TO RNUM3
7100 GET #3, Q
7120 ENG$(R) = EE$: DRE$(R) = "2": R = R + 1: ZEA = ZEA + 1
7140 NEXT Q
7160 NEWR = R - 1
7180 FOR C = 1 TO CNUM:Y = Y + 1
7200 GET #2, Y
7220 IF TSK$(C) <> RT$ THEN DRT$(C) = "1":Y = Y - 1:ZT = ZT + 1
7240 NEXT C
7260 FOR Q2 = Y + 1 TO CNUM2
7280 GET #2, Q2
7300 TSK$(C) = RT$: DRT$(C) = "2": C = C + 1: ZTA = ZTA + 1
7320 NEXT Q2
7340 NEWC = C - 1
7360 CLOSE #1: CLOSE #2: CLOSE #3
7380 IF ZE = 0 THEN 7500
7400 PRINT CHR$(12):PRINT "THE FOLLOWING ";ZE;" ENGAGEMENTS HAVE BEEN DROPPED
EARLIER,"
```

```
7420 PRINT "AND THE TASK PRACTICE VALUES WILL BE DROPPED."
7440 FOR R = 1 TO RNUM
7460 IF DRE$(R) <> "" THEN PRINT:PRINT ENG$(R);
7480 NEXT R
7500 IF ZT = 0 THEN 7620
7520 PRINT:PRINT:PRINT "THE FOLLOWING ";ZT;" TASKS HAVE BEEN DROPPED EARLIER,"
7540 PRINT "AND THE TASK PRACTICE VALUES WILL BE DROPPED. "
7560 FOR C = 1 TO CNUM
7580 IF DRT$(C) = "1" THEN PRINT:PRINT TSK$(C);
7600 NEXT C
7620 IF ZEA = 0 THEN 7720
7640 PRINT:PRINT:PRINT "THE FOLLOWING ";ZEA;" ENGAGEMENTS HAVE BEEN ADDED, AND
TASK PRACTICE VALUES ARE NEEDED:"
7660 FOR R = 1 TO NEWR
7680 IF DRE$(R) = "2" THEN PRINT:PRINT ENG$(R);
7700 NEXT R
7720 IF ZTA = 0 THEN 7820
7740 PRINT:PRINT:PRINT "THE FOLLOWING ";ZTA;" TASKS HAVE BEEN ADDED, AND TASK
PRACTICE VALUES AND LEARNING RATES ARE NEEDED:"
7760 FOR C = 1 TO NEWC
7780 IF DRT$(C) = "2" THEN PRINT:PRINT TSK$(C);
7800 NEXT C
7820 IF ZE = 0 AND ZT = 0 THEN 7880
7840 PRINT:PRINT:PRINT "CONTINUE BY DROPPING TASKS AND/OR ENGAGEMENTS (Y) OR
ABORT (PRESS ANY KEY OTHER THAN Y)?"
7860 A6$ = INKEY$: IF A6$ = "" THEN 7860 ELSE IF A6$ <> "Y" THEN SEL =
6:RETURN
7880 IF ZEA = 0 AND ZTA = 0 AND ZE = 0 AND ZT = 0 THEN 8140
7900 KILL "PDATA"
7920 OPEN "O", #1, "PDATA"
7940 RNUM = RNUM3:CNUM = CNUM2
7960 WRITE #1, RNUM, CNUM
7980 FOR R = 1 TO NEWR
8000 IF DRE$(R) = "1" THEN 8120
8020 WRITE #1, ENG$(R)
8040 FOR C = 1 TO NEWC
8060 IF DRT$(C) = "1" THEN 8100
8080 WRITE #1, TSK$(C), P(R,C), K(C)
8100 NEXT C
8120 NEXT R
8140 CLOSE #1: CLOSE #2: CLOSE #3: RETURN
8160 REM *** PRINT HARD COPY OF PRACTICE PER ENGAGEMENTS ******************
8180 PRINT:PRINT:PRINT "READING IN DATA FOR PRINT ...":PRINT
8200 OPEN "I", #1, "PDATA"
8220 INPUT#1, RNUM, CNUM
8240 FOR R = 1 TO RNUM
8260 INPUT#1, ENG$(R)
8280 FOR C = 1 TO CNUM
8300 INPUT#1, TSK$(C), P(R,C), K(C)
```

PROGRAM LISTING: PDATASET.MRR (Continued)

```
8320 NEXT C:NEXT R
8340 LPRINT "PRACTICE PER ENGAGEMENT VALUES AND LEARNING RATES"
8360 LPRINT:LPRINT RNUM;" MRR ENGAGEMENTS,";CNUM;"TASKS"
8380 LPRINT:LPRINT "ENG'T" TAB(7) "TASK PRACTICE VALUES":LPRINT TAB(7);
8400 FOR C = 1 TO CNUM:LPRINT TSK$(C) SPC(1);:NEXT C
8420 FOR R = 1 TO RNUM:LPRINT:LPRINT ENG$(R) TAB(5);
8440 FOR C = 1 TO CNUM
8460 LPRINT USING "###";P(R,C);
8480 NEXT C: NEXT R
8500 LPRINT:LPRINT:LPRINT "LEARNING RATES: ":LPRINT TAB(5)
8520 FOR C = 1 TO CNUM
8540 IF K(C) = 1.3 THEN K$(C) = "H" ELSE IF K(C) = .5 THEN K$(C) = "E" ELSE
K$(C) = "M"
8560 LPRINT SPC(2) K$(C);
8580 NEXT C
8600 CLOSE#1
8620 OPEN "I",#1,"P2DATA"
8640 INPUT#1, L, CNUM
8660 FOR R = 1 TO L
8680 INPUT #1, EN2$(R),S2(R)
8700 FOR C = 1 TO CNUM
8720 INPUT#1, TSK$(C), P2(R,C), K(C)
8740 NEXT C:NEXT R
8760 CLOSE#1
8780 LPRINT:LPRINT:LPRINT:LPRINT "TASK PRACTICE PER SITUATIONALLY RELATED
ENGAGEMENTS"
8800 LPRINT:LPRINT L;"ENGAGEMENT SETS"
8820 LPRINT:LPRINT "SET" TAB(5) "ENGTS" TAB(11) "TASKS":LPRINT TAB(11);
8840 FOR C = 1 TO CNUM:LPRINT TSK$(C) SPC(1);:NEXT C
8860 FOR R = 1 TO L: LPRINT:LPRINT EN2$(R) TAB(5) S2(R) TAB(9);
8880 FOR C = 1 TO CNUM: LPRINT USING "###";P2(R,C);
8900 NEXT C:NEXT R
8920 OPEN "I", #1, "P3DATA"
8940 INPUT#1, L, CNUM
8960 FOR R = 1 TO L
8980 INPUT#1, EN3$(R), S3(R)
9000 FOR C = 1 TO CNUM
9020 INPUT#1, TSK$(C), P3(R,C), K(C)
9040 NEXT C:NEXT R
9060 CLOSE#1
9080 LPRINT:LPRINT:LPRINT:LPRINT "TASK PRACTICE PER FORCE-ON-FORCE ENGAGEMENT
SCENARIOS"
9100 LPRINT:LPRINT L;"ENGAGEMENT SCENARIOS"
9120 LPRINT:LPRINT "SCEN" TAB(6) "ENGTS" TAB(12) "TASKS":LPRINT TAB(12);
9140 FOR C = 1 TO CNUM:LPRINT TSK$(C) SPC(1);:NEXT C
9160 FOR R = 1 TO L:LPRINT:LPRINT EN3$(R) TAB(6) S3(R) TAB(10);
9180 FOR C = 1 TO CNUM
9200 LPRINT USING "###";P3(R,C);
9220 NEXT C:NEXT R
9240 LPRINT CHR$(12):RETURN
9260 END
```

PROGRAM LISTING: SELECT.MRR

```
20 LPRINT CHR$(27);CHR$(78);CHR$(6); ' SELECT.MRR  7/18/89
60 LPRINT "PROGRAM SELECT FOR MOTORIZED RIFLE REGIMENTS  TIME: ";TIME$;"
DATE: ";DATE$
80 PRINT "THIS PROGRAM SELECTS MOTORIZED RIFLE REGIMENT ENGAGEMENTS FOR"
100 PRINT "TRAINING, BASED ON CURRENT PROFICIENCY ON TASKS, METL-RATED"
120 PRINT "IMPORTANCE OF TASKS, LEARNING DIFFICULTY PER TASK, AND "
140 PRINT "PRACTICE PER TASK OFFERED BY EACH ENGAGEMENT.  IT SELECTS"
160 PRINT "ENGAGEMENTS ACCORDING TO THEIR CONTRIBUTION TO PRACTICE"
180 PRINT "ON TASKS, USING A LEARNING CURVE."
200 OPTION BASE 1
220 DIM P(55,40), K(40), T(40), I(40), TEX(40), ENG$(55), TSK$(40), F(55)
240 LET X = 0
260 REM *** CHOOSE TYPE OF SELECTION METHOD **************************
280 PRINT:PRINT:PRINT "CHOOSE AN ENGAGEMENT SELECTION METHOD:":PRINT
300 PRINT 1;"   SELECTION OF INDIVIDUAL MRR ENGAGEMENTS, FROM THE FULL SET."
320 PRINT 2;"   SELECTION OF SETS OF SITUATIONALLY RELATED MRR ENGAGEMENTS."
340 PRINT 3;"   SELECTION OF FORCE-ON-FORCE MRR ENGAGEMENT SCENARIOS."
360 PRINT 4;"   END SELECTION OF MRR ENGAGEMENTS."
380 PRINT:PRINT:PRINT "SELECT A NUMBER: "
400 A$ = INKEY$:IF A$ = "" THEN 400 ELSE SEL = VAL(A$)
420 IF SEL < 1 OR SEL > 4 THEN 280
440 IF SEL = 4 THEN PRINT:PRINT "END OF SELECT.MRR PROGRAM.":END
460 PRINT:PRINT:PRINT "READING IN DATA...":PRINT
480 ON SEL GOTO 500, 680, 920
500 REM *** READ IN P MATRIX OF PRACTICE PER ENGAGEMENT VALUES ***************
520 OPEN "I", #1, "PDATA"
540 INPUT#1, RNUM, CNUM
560 FOR R = 1 TO RNUM
580 INPUT #1, ENG$(R)
600 FOR C = 1 TO CNUM
620 INPUT#1, TSK$(C), P(R,C), K(C)
640 NEXT C:NEXT R
660 GOTO 1140
680 REM *** INPUT P2 MATRIX FOR SITUATIONALLY RELATED PRACTICE VALUES *****
700 ERASE P, ENG$
720 DIM EN2$(22), S2(22), P2(22,40), P(22,40), ENG$(22)
740 OPEN "I", #1, "P2DATA"
760 INPUT#1, L, CNUM:RNUM = L
780 FOR R = 1 TO RNUM
800 INPUT#1, EN2$(R),S2(R):ENG$(R) = EN2$(R)
820 FOR C = 1 TO CNUM
840 INPUT #1, TSK$(C), P2(R,C), K(C): P(R,C) = P2(R,C)
860 NEXT C:NEXT R
880 ERASE EN2$, P2
900 GOTO 1140
920 REM *** INPUT P3 MATRIX FOR FORCE-ON-FORCE ********************************
940 ERASE P, ENG$
960 DIM EN3$(15), S3(15), P3(15,40), P(15,40), ENG$(15)
980 OPEN "I", #1, "P3DATA"
```

PROGRAM LISTING: SELECT.MRR (Continued)

```
1000 INPUT#1, L, CNUM:RNUM = L
1020 FOR R = 1 TO RNUM
1040 INPUT#1, EN3$(R),S3(R):ENG$(R) = EN3$(R)
1060 FOR C = 1 TO CNUM
1080 INPUT #1, TSK$(C), P3(R,C), K(C): P(R,C) = P3(R,C)
1100 NEXT C:NEXT R
1120 ERASE EN3$, P3
1140 CLOSE #1
1160 REM *** INPUT TASK IMPORTANCE AND CURRENT PROFICIENCY***************
1180 DIM IIN(40), TIN(40)
1200 PRINT:PRINT "ENTER TASK IMPORTANCE:  1, 2, OR 3, WHERE 3 = VERY
IMPORTANT.":PRINT
1220 FOR C = 1 TO CNUM
1240 PRINT "  TASK ";TSK$(C);
1260 INPUT ":",I(C)
1280 IF I(C) < 1 OR I(C) > 3 THEN PRINT:PRINT "MUST BE 1, 2, OR 3.":GOTO 1240
1300 IIN(C) = I(C)
1320 NEXT C
1340 PRINT:PRINT "ENTER CURRENT TASK PERCENT PROFICIENCY, BETWEEN 10 AND
90.":PRINT
1360 FOR C = 1 TO CNUM
1380 PRINT "  TASK ";TSK$(C);
1400 INPUT ":",T(C)
1420 IF T(C) < 10 OR T(C) > 90 THEN PRINT:PRINT "MUST BE BETWEEN 10 AND 90.":
GOTO 1380
1440 TIN(C) = T(C)
1460 NEXT C
1480 REM *** SET INITIAL LEVEL BASED ON PROFICIENCY **********************
1500 FOR C = 1 TO CNUM
1520 I(C) = I(C)^2
1540 T(C) = (T(C)/100)*(.9)
1560 TEX(C) = (K(C)*T(C))/(1-T(C))
1580 NEXT C
1600 REM *** PRINT TASK DATA ************************************
1620 IX = INT((CNUM * 7)/65) + 1
1640 LPRINT:LPRINT:LPRINT TAB(16) "TASKS"
1660 FOR X = 1 TO IX
1680 LPRINT TAB(16);
1700 FOR C = 9 * (X - 1) + 1 TO 9 * X
1720 LPRINT TSK$(C) SPC(5);
1740 IF C = CNUM THEN 1780
1760 NEXT C
1780 LPRINT:LPRINT "DIFFICULTY" TAB(15);
1800 FOR C = 9 * (X-1) + 1 TO 9 * X
1820 LPRINT USING " #.#   ";K(C);
1840 IF C = CNUM THEN 1880
1860 NEXT C
1880 LPRINT:LPRINT "IMPORTANCE" TAB(15);
1900 FOR C = 9 * (X-1) + 1 TO 9 * X
```

PROGRAM LISTING: SELECT.MRR (Continued)

```
1920 LPRINT USING "  #     ";IIN(C);
1940 IF C = CNUM THEN 1980
1960 NEXT C
1980 LPRINT:LPRINT "PROFICIENCY" TAB(15);
2000 FOR C = 9 * (X-1) + 1 TO 9 * X
2020 LPRINT USING " ##     ";TIN(C);
2040 IF C = CNUM THEN 2080
2060 NEXT C
2080 LPRINT:LPRINT "INITIAL LEVEL" TAB(14);
2100 FOR C = 9 * (X-1) + 1 TO 9 * X
2120 LPRINT USING "###.###";TEX(C);
2140 IF C = CNUM THEN 2180
2160 NEXT C
2180 LPRINT:LPRINT
2200 NEXT X
2220 ERASE IIN, TIN
2240 REM *** START LOOP TO REPEAT FOR N = NUMBER OF ENGAGEMENTS ***********
2260 DIM SUM(55), ELM(55,40), EVM(55,40), Q(55), QT$(55), QX(55)
2280 FOR N = 1 TO RNUM
2300 PRINT:PRINT "CALCULATING AT STEP ";N;" OF ";RNUM;"..."
2320 FOR R = 1 TO RNUM
2340 SUM(R) = 0
2360 FOR C = 1 TO CNUM
2380 IF QX(R) = 1 THEN 2480
2400 ELM(R,C) = ((P(R,C) + TEX(C))/((P(R,C) + TEX(C)) + K(C))) - T(C)
2420 EVM(R,C) = ELM(R,C)*I(C)
2440 SUM(R) = SUM(R)+EVM(R,C)
2460 NEXT C
2480 NEXT R
2500 REM *** DETERMINE MAX ENGAGEMENT ************************************
2520 MAX = SUM(1)
2540 X = 1
2560 FOR R = 2 TO RNUM
2580 IF QX(R) = 1 THEN 2660
2600 IF MAX >= SUM(R) GOTO 2660
2620 LET MAX = SUM(R)
2640 X = R
2660 NEXT R
2680 Q(N) = X:QT$(N) = ENG$(X): QX(X) = 1
2700 REM *** CUMULATE CONTRIBUTIONS FOR SELECTED ENGAGEMENTS **************
2720 FOR C = 1 TO CNUM
2740 TEX(C) = TEX(C) + P(X,C)
2760 T(C) = TEX(C)/(TEX(C) + K(C))
2780 NEXT C
2800 NEXT N
2820 ERASE P, K, T, I, TEX, ELM, EVM, SUM, QX
2840 REM *** CONSTRUCT SIMILARITY MATRIX BEFORE PRINT*******************
2860 PRINT:PRINT "CONSTRUCTING SIMILARITY MATRIX ...":PRINT
2880 TNK% = 0: BMP% = 0: OTH% = 0: TRP% = 0
```

PROGRAM LISTING: SELECT.MRR (Continued)

```
2900 OPEN "R", #1, "ENG"
2920 FIELD #1, 3 AS EE$, 40 AS DE$, 2 AS TE$, 2 AS BE$, 3 AS PE$, 2 AS OE$, 4
AS FE$, 4 AS LE$, 5 AS RGE$, 3 AS MRE$, 3 AS MBE$, 2 AS CE$
2940 RX = LOF(1)/128
2960 DIM W$(55,55), WN(55), CTR(55)
2980 FOR I2 = 1 TO RX
3000 EN = 0
3020 FOR I = 1 TO RX
3040 GET #1,I
3060 IF VAL(CE$) <> I2 THEN 3120
3080 EN = EN + 1
3100 W$(I2,EN) = EE$
3120 NEXT I
3140 IF EN = 0 THEN 3200
3160 WN(I2) = EN: CTR(I2) = EN-1
3180 NEXT I2
3200 REM *** PRINT ENGAGEMENTS IN ORDER SELECTED **********************
3220 LPRINT CHR$(12):LPRINT "ENGAGEMENTS WERE SELECTED FOR TRAINING IN THE
FOLLOWING ORDER:"
3240 LPRINT:LPRINT "STEP ENGT ENGAGEMENT DESCRIPTION" TAB(56) "TANK BMP TROOPS
OTHER"
3260 FOR J = 1 TO RNUM
3280 FOR I = 1 TO RX
3300 GET #1, I
3320 IF SEL <> 1 THEN 3360
3340 IF QT$(J) = EE$ THEN 3460 ELSE 3940
3360 IF SEL <> 2 THEN 3400
3380 IF QT$(J) = LEFT$(EE$,2) THEN 3460 ELSE 3940
3400 REM SEL = 3
3420 IF RIGHT$(EE$,2) = "00" AND QT$(J) = LEFT$(EE$,1) THEN 3460
3440 IF LEFT$(EE$,1) = "7" AND QT$(J) = LEFT$(EE$,2) THEN 3460 ELSE 3940
3460 IF LEFT$(EE$,1) = "7" THEN LPRINT:LPRINT TAB(1) J TAB(6) EE$ TAB(11)
"ENHANCEMENT: ";DE$ TAB(76) OE$:LPRINT TAB(11) "RANGE ";RGE$;"M":GOTO 3720
3480 LPRINT:LPRINT TAB(1) J TAB(6) EE$ TAB(11) DE$ TAB(57) TE$ TAB(62) BE$
TAB(67) PE$ TAB(74) OE$
3500 LPRINT TAB(11) "FRONTAGE ";FE$;"M, DEPTH ";LE$;"M, RANGE ";RGE$;"M"
3520 IF MRE$ = "MOV" THEN MOVR$ = "MOVING"
3540 IF MRE$ = "STA" THEN MOVR$ = "STATIONARY"
3560 IF MBE$ = "MOV" THEN MOVB$ = "MOVING"
3580 IF MBE$ = "STA" THEN MOVB$ = "STATIONARY"
3600 LPRINT TAB(11) "RED ";MOVR$;", BLUE ";MOVB$;
3620 TNK% = TNK% + VAL(TE$)
3640 BMP% = BMP% + VAL(BE$)
3660 OTH% = OTH% + VAL(OE$)
3680 TRP% = TRP% + VAL(PE$)
3700 LPRINT TAB(51) "TOTAL" TAB(57) TNK% TAB(62) BMP% TAB(67) TRP% TAB(74)
OTH%
3720 IF SEL <> 1 THEN 3940
3740 I2 = VAL(CE$)
```

PROGRAM LISTING: SELECT.MRR (Continued)

```
3760 IF CTR(I2) = 0 THEN 3940
3780 LPRINT TAB(6) "CLUSTER ";CE$;".  SIMILAR ENGAGEMENTS ARE: ":LPRINT
TAB(17);
3800 FOR N = 1 TO WN(I2)
3820 IF W$(I2,N) = EE$ THEN W$(I2,N) = "": GOTO 3880
3840 IF W$(I2,N) = "" THEN 3880
3860 LPRINT W$(I2,N) SPC(2);
3880 NEXT N
3900 LPRINT:LPRINT:LPRINT
3920 CTR(I2) = CTR(I2) - 1: GOTO 3960
3940 NEXT I
3960 NEXT J
3980 CLOSE #1:LPRINT CHR$(12)
4000 PRINT:PRINT:PRINT "END OF SELECTION PROGRAM."
4020 END
```

Appendix F

Sample Output for SELECT Program

OUTPUT FROM PROGRAM SELECT.MRR FOR MOTORIZED RIFLE REGIMENTS

	TASKS 01	02	03	04	05	06	07	08	09
DIFFICULTY	0.5	0.5	0.5	0.5	1.3	0.5	0.5	0.5	0.5
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.281	0.587	1.526	0.587	2.132	2.132	2.132
	10	11	12	13	14	15	16	17	18
DIFFICULTY	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.3	1.3
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.281	0.587	0.587	0.587	2.132	5.542	5.542
	19	20	21	22	23	24	25	26	27
DIFFICULTY	0.5	1.3	0.5	0.5	1.3	0.5	0.5	0.5	1.3
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.731	0.281	0.587	1.526	0.587	2.132	2.132	5.542
	28	29	30	31	32	33	34	35	36
DIFFICULTY	0.5	0.5	1.3	0.5	0.5	0.5	0.5	0.5	0.5
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.731	0.587	0.587	0.587	2.132	2.132	2.132

CALCULATING AT STEP 1 OF 51 ...

CALCULATING AT STEP 2 OF 51 ...

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OUTPUT FROM PROGRAM SELECT.MRR (Continued)

ENGAGEMENTS WERE SELECTED FOR TRAINING IN THE FOLLOWING ORDER:

STEP	ENGT	ENGAGEMENT DESCRIPTION		TANK	BMP	TROOPS	OTHER
1	112	RED ATTACK BLUE DEFEND H2		8	17	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	8	17	0	0
		CLUSTER 06. SIMILAR ENGAGEMENTS ARE: 122 212 222					
2	312	RED MEETING BLUE ATTACK H2		2	8	0	0
		FRONTAGE 400M, DEPTH 400M, RANGE 1000M					
		RED MOVING, BLUE MOVING	TOTAL	10	25	0	0
		CLUSTER 10. SIMILAR ENGAGEMENTS ARE: 412 512					
3	111	RED ATTACK BLUE DEFEND H1		10	23	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	20	48	0	0
		CLUSTER 02. SIMILAR ENGAGEMENTS ARE: 121 211 221					
4	313	RED MEETING BLUE ATTACK H3		2	6	28	0
		FRONTAGE 400M, DEPTH 250M, RANGE 400M					
		RED STATIONARY, BLUE MOVING	TOTAL	22	54	28	0
		CLUSTER 11. SIMILAR ENGAGEMENTS ARE: 413 513					
5	740	ENHANCEMENT: ELECTRONIC WARFARE (EW)					1
		RANGE 400M					
6	121	RED ATTACK BLUE DEFEND L1		10	27	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	32	81	28	0
		CLUSTER 02. SIMILAR ENGAGEMENTS ARE: 211 221					
7	760	ENHANCEMENT: NBC ARTY BTY					6
		RANGE 400M					
8	770	ENHANCEMENT: OBSTACLE					3
		RANGE 400M					
9	750	ENHANCEMENT: NBC YAK-28					1
		RANGE 400M					
10	413	RED DEL. DEFENSE BLUE ATTACK H3		2	6	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 400M					
		RED STATIONARY, BLUE MOVING	TOTAL	34	87	28	0
		CLUSTER 11. SIMILAR ENGAGEMENTS ARE: 513					

OUTPUT FROM PROGRAM SELECT.MRR (Continued)

11	211	RED MEETING BLUE DEFENSE H1	3	8	0	6
		FRONTAGE 400M, DEPTH 1800M, RANGE 2000M				
		RED MOVING, BLUE STATIONARY TOTAL	37	95	28	6
		CLUSTER 02. SIMILAR ENGAGEMENTS ARE: 221				
12	513	RED WITHDRAWAL BLUE ATTACK H3	1	1	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 400M				
		RED STATIONARY, BLUE MOVING TOTAL	38	96	28	6
13	221	RED MEETING BLUE DEFENSE L1	3	11	0	6
		FRONTAGE 400M, DEPTH 1800M, RANGE 2000M				
		RED MOVING, BLUE STATIONARY TOTAL	41	107	28	12
14	612	RED BREAKTHROUGH BLUE DEFENSE H2	7	2	14	2
		FRONTAGE 500M, DEPTH 250M, RANGE -1000M				
		RED MOVING, BLUE STATIONARY TOTAL	48	109	42	14
		CLUSTER 04. SIMILAR ENGAGEMENTS ARE: 613 622 623				
15	323	RED MEETING BLUE ATTACK L3	3	10	49	0
		FRONTAGE 400M, DEPTH 250M, RANGE 400M				
		RED MOVING, BLUE MOVING TOTAL	51	119	91	14
		CLUSTER 12. SIMILAR ENGAGEMENTS ARE: 423 523				
16	100	RED ATTACK BLUE DEFEND INITIAL	12	28	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 3000M				
		RED MOVING, BLUE STATIONARY TOTAL	63	147	91	14
		CLUSTER 01. SIMILAR ENGAGEMENTS ARE: 200				
17	400	RED DEL. DEFENSE BLUE ATTACK INITIAL	4	12	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 3000M				
		RED STATIONARY, BLUE MOVING TOTAL	67	159	91	14
		CLUSTER 07. SIMILAR ENGAGEMENTS ARE: 500				
18	780	ENHANCEMENT: INDIRECT FIRE				8
		RANGE 400M				
19	423	RED DEL. DEFENSE BLUE ATTACK L3	3	10	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 400M				
		RED STATIONARY, BLUE MOVING TOTAL	70	169	91	14
		CLUSTER 12. SIMILAR ENGAGEMENTS ARE: 523				

OUTPUT FROM PROGRAM SELECT.MRR (Continued)

20	710	ENHANCEMENT: TACAIR FROGFOOT RANGE 400M					2
21	200	RED MEETING BLUE DEFENSE INITIAL		4	11	0	6
		FRONTAGE 400M, DEPTH 800M, RANGE 3000M					
		RED MOVING, BLUE STATIONARY	TOTAL	74	180	91	20
22	523	RED WITHDRAWAL BLUE ATTACK L3		1	3	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 400M					
		RED STATIONARY, BLUE MOVING	TOTAL	75	183	91	20
23	122	RED ATTACK BLUE DEFEND L2		9	25	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	84	208	91	20
		CLUSTER 06. SIMILAR ENGAGEMENTS ARE: 212 222					
24	613	RED BREAKTHROUGH BLUE DEFENSE H3		3	2	14	2
		FRONTAGE 500M, DEPTH 250M, RANGE -2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	87	210	105	22
		CLUSTER 04. SIMILAR ENGAGEMENTS ARE: 622 623					
25	500	RED WITHDRAWAL BLUE ATTACK INITIAL		1	4	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 3000M					
		RED STATIONARY, BLUE MOVING	TOTAL	88	214	105	22
26	212	RED MEETING BLUE DEFENSE H2		3	6	0	4
		FRONTAGE 400M, DEPTH 2800M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	91	220	105	26
		CLUSTER 06. SIMILAR ENGAGEMENTS ARE: 222					
27	790	ENHANCEMENT: SMOKE RANGE 1000M					6
28	412	RED DEL. DEFENSE BLUE ATTACK H2		2	8	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 1000M					
		RED STATIONARY, BLUE MOVING	TOTAL	93	228	105	26
		CLUSTER 10. SIMILAR ENGAGEMENTS ARE: 512					
29	720	ENHANCEMENT: ATTACK HEL HIND-D ATGM RANGE 2000M					4
		CLUSTER 13. SIMILAR ENGAGEMENTS ARE: 730					

OUTPUT FROM PROGRAM SELECT.MRR (Continued)

30	622	RED BREAKTHROUGH BLUE DEFENSE L2	8	2	0	2
		FRONTAGE 500M, DEPTH 250M, RANGE -1000M				
		RED MOVING, BLUE STATIONARY TOTAL	101	230	105	28
		CLUSTER 04. SIMILAR ENGAGEMENTS ARE: 623				
31	222	RED MEETING BLUE DEFENSE L2	3	10	0	5
		FRONTAGE 400M, DEPTH 2800M, RANGE 1000M				
		RED MOVING, BLUE STATIONARY TOTAL	104	240	105	33
32	512	RED WITHDRAWAL BLUE ATTACK H2	1	2	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 1000M				
		RED STATIONARY, BLUE MOVING TOTAL	105	242	105	33
33	623	RED BREAKTHROUGH BLUE DEFENSE L3	8	2	0	2
		FRONTAGE 500M, DEPTH 250M, RANGE -2000M				
		RED MOVING, BLUE STATIONARY TOTAL	113	244	105	35
34	322	RED MEETING BLUE ATTACK L2	3	11	0	0
		FRONTAGE 400M, DEPTH 400M, RANGE 1000M				
		RED MOVING, BLUE MOVING TOTAL	116	255	105	35
		CLUSTER 09. SIMILAR ENGAGEMENTS ARE: 411 421 422 511 521 522				
35	411	RED DEL. DEFENSE BLUE ATTACK H1	4	10	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 2000M				
		RED STATIONARY, BLUE MOVING TOTAL	120	265	105	35
		CLUSTER 09. SIMILAR ENGAGEMENTS ARE: 421 422 511 521 522				
36	730	ENHANCEMENT: ATTACK HEL HIND-D ASLT				4
		RANGE 400M				
37	421	RED DEL. DEFENSE BLUE ATTACK L1	4	11	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 2000M				
		RED STATIONARY, BLUE MOVING TOTAL	124	276	105	35
		CLUSTER 09. SIMILAR ENGAGEMENTS ARE: 422 511 521 522				
38	611	RED BREAKTHROUGH BLUE DEFENSE H1	9	2	0	2
		FRONTAGE 500M, DEPTH 150M, RANGE -400M				
		RED MOVING, BLUE STATIONARY TOTAL	133	278	105	37
		CLUSTER 05. SIMILAR ENGAGEMENTS ARE: 621				
39	422	RED DEL. DEFENSE BLUE ATTACK L2	4	10	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 1000M				
		RED STATIONARY, BLUE MOVING TOTAL	137	288	105	37
		CLUSTER 09. SIMILAR ENGAGEMENTS ARE: 511 521 522				

OUTPUT FROM PROGRAM SELECT.MRR (Continued)

40	621	RED BREAKTHROUGH BLUE DEFENSE L1		9	2	0	2
		FRONTAGE 500M, DEPTH 250M, RANGE	-400M				
		RED MOVING, BLUE STATIONARY	TOTAL	146	290	105	39
41	511	RED WITHDRAWAL BLUE ATTACK H1		1	3	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE	2000M				
		RED STATIONARY, BLUE MOVING	TOTAL	147	293	105	39
		CLUSTER 09. SIMILAR ENGAGEMENTS ARE: 521 522					
42	521	RED WITHDRAWAL BLUE ATTACK L1		1	4	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE	2000M				
		RED STATIONARY, BLUE MOVING	TOTAL	148	297	105	39
		CLUSTER 09. SIMILAR ENGAGEMENTS ARE: 522					
43	113	RED ATTACK BLUE DEFEND H3		7	13	77	0
		FRONTAGE 750M, DEPTH 400M, RANGE	400M				
		RED MOVING, BLUE STATIONARY	TOTAL	155	310	182	39
		CLUSTER 03. SIMILAR ENGAGEMENTS ARE: 123 213 223					
44	522	RED WITHDRAWAL BLUE ATTACK L2		1	4	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE	1000M				
		RED STATIONARY, BLUE MOVING	TOTAL	156	314	182	39
45	123	RED ATTACK BLUE DEFEND L3		8	24	140	0
		FRONTAGE 1500M, DEPTH 400M, RANGE	400M				
		RED MOVING, BLUE STATIONARY	TOTAL	164	338	322	39
		CLUSTER 03. SIMILAR ENGAGEMENTS ARE: 213 223					
46	300	RED MEETING BLUE ATTACK INITIAL		4	12	0	0
		FRONTAGE 400M, DEPTH 800M, RANGE	3000M				
		RED MOVING, BLUE MOVING	TOTAL	168	350	322	39
47	213	RED MEETING BLUE DEFENSE H3		2	4	14	4
		FRONTAGE 400M, DEPTH 3400M, RANGE	400M				
		RED MOVING, BLUE STATIONARY	TOTAL	170	354	336	43
		CLUSTER 03. SIMILAR ENGAGEMENTS ARE: 223					
48	223	RED MEETING BLUE DEFENSE L3		2	10	42	5
		FRONTAGE 400M, DEPTH 3400M, RANGE	400M				
		RED MOVING, BLUE STATIONARY	TOTAL	172	364	378	48

OUTPUT FROM PROGRAM SELECT.MRR (Continued)

49	311	RED MEETING BLUE ATTACK H1		3	10	0	0
		FRONTAGE 400M, DEPTH 800M, RANGE 2000M					
		RED MOVING, BLUE MOVING	TOTAL	175	374	378	48

CLUSTER 08. SIMILAR ENGAGEMENTS ARE:
321

50	321	RED MEETING BLUE ATTACK L1		3	12	0	0
		FRONTAGE 400M, DEPTH 800M, RANGE 2000M					
		RED MOVING, BLUE MOVING	TOTAL	178	386	378	48
51	600	RED BREAKTHROUGH BLUE DEFENSE INITIAL		10	3	0	2
		FRONTAGE 500M, DEPTH 250M, RANGE 0M					
		RED MOVING, BLUE STATIONARY	TOTAL	188	389	378	50

END OF SELECTION PROGRAM.

OUTPUT FROM PROGRAM SELECT.MRR FOR MOTORIZED RIFLE REGIMENTS

SELECTION OF SITUATIONALLY RELATED ENGAGEMENT SETS

	TASKS								
	01	02	03	04	05	06	07	08	09
DIFFICULTY	0.5	0.5	0.5	0.5	1.3	0.5	0.5	0.5	0.5
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.281	0.587	1.526	0.587	2.132	2.132	2.132
	10	11	12	13	14	15	16	17	18
DIFFICULTY	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.3	1.3
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.281	0.587	0.587	0.587	2.132	5.542	5.542
	19	20	21	22	23	24	25	26	27
DIFFICULTY	0.5	1.3	0.5	0.5	1.3	0.5	0.5	0.5	1.3
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.731	0.281	0.587	1.526	0.587	2.132	2.132	5.542
	28	29	30	31	32	33	34	35	36
DIFFICULTY	0.5	0.5	1.3	0.5	0.5	0.5	0.5	0.5	0.5
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.731	0.587	0.587	0.587	2.132	2.132	2.132

CALCULATING AT STEP 1 OF 21 ...

CALCULATING AT STEP 2 OF 21 ...

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OUTPUT FROM PROGRAM SELECT.MRR: SITUATIONALLY RELATED ENGAGEMENT SETS

ENGAGEMENT SETS WERE SELECTED FOR TRAINING IN THE FOLLOWING ORDER:

STEP	ENGT	ENGAGEMENT DESCRIPTION		TANK	BMP	TROOPS	OTHER
1	111	RED ATTACK BLUE DEFEND H1		10	23	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	10	23	0	0
1	112	RED ATTACK BLUE DEFEND H2		8	17	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	18	40	0	0
1	113	RED ATTACK BLUE DEFEND H3		7	13	77	0
		FRONTAGE 750M, DEPTH 400M, RANGE 400M					
		RED MOVING, BLUE STATIONARY	TOTAL	25	53	77	0
2	311	RED MEETING BLUE ATTACK H1		3	10	0	0
		FRONTAGE 400M, DEPTH 800M, RANGE 2000M					
		RED MOVING, BLUE MOVING	TOTAL	28	63	77	0
2	312	RED MEETING BLUE ATTACK H2		2	8	0	0
		FRONTAGE 400M, DEPTH 400M, RANGE 1000M					
		RED MOVING, BLUE MOVING	TOTAL	30	71	77	0
2	313	RED MEETING BLUE ATTACK H3		2	6	28	0
		FRONTAGE 400M, DEPTH 250M, RANGE 400M					
		RED STATIONARY, BLUE MOVING	TOTAL	32	77	105	0
3	121	RED ATTACK BLUE DEFEND L1		10	27	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	42	104	105	0
3	122	RED ATTACK BLUE DEFEND L2		9	25	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	51	129	105	0
3	123	RED ATTACK BLUE DEFEND L3		8	24	140	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 400M					
		RED MOVING, BLUE STATIONARY	TOTAL	59	153	245	0
4	740	ENHANCEMENT: ELECTRONIC WARFARE (EW)					1
		RANGE 400M					
5	411	RED DEL. DEFENSE BLUE ATTACK H1		4	10	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 2000M					
		RED STATIONARY, BLUE MOVING	TOTAL	63	163	245	0
5	412	RED DEL. DEFENSE BLUE ATTACK H2		2	8	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 1000M					
		RED STATIONARY, BLUE MOVING	TOTAL	65	171	245	0

OUTPUT FROM PROGRAM SELECT.MRR: SITUATIONALLY RELATED ENGAGEMENT SETS
(Continued)

5	413	RED DEL. DEFENSE BLUE ATTACK H3		2	6	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 400M					
		RED STATIONARY, BLUE MOVING	TOTAL	67	177	245	0
6	211	RED MEETING BLUE DEFENSE H1		3	8	0	6
		FRONTAGE 400M, DEPTH 1800M, RANGE 2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	70	185	245	6
6	212	RED MEETING BLUE DEFENSE H2		3	6	0	4
		FRONTAGE 400M, DEPTH 2800M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	73	191	245	10
6	213	RED MEETING BLUE DEFENSE H3		2	4	14	4
		FRONTAGE 400M, DEPTH 3400M, RANGE 400M					
		RED MOVING, BLUE STATIONARY	TOTAL	75	195	259	14
7	760	ENHANCEMENT: NBC ARTY BTY					6
		RANGE 400M					
8	770	ENHANCEMENT: OBSTACLE					3
		RANGE 400M					
9	750	ENHANCEMENT: NBC YAK-28					1
		RANGE 400M					
10	511	RED WITHDRAWAL BLUE ATTACK H1		1	3	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 2000M					
		RED STATIONARY, BLUE MOVING	TOTAL	76	198	259	14
10	512	RED WITHDRAWAL BLUE ATTACK H2		1	2	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 1000M					
		RED STATIONARY, BLUE MOVING	TOTAL	77	200	259	14
10	513	RED WITHDRAWAL BLUE ATTACK H3		1	1	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 400M					
		RED STATIONARY, BLUE MOVING	TOTAL	78	201	259	14
11	221	RED MEETING BLUE DEFENSE L1		3	11	0	6
		FRONTAGE 400M, DEPTH 1800M, RANGE 2000M					
		RED MOVING, BLUE STATIONARY	TOTAL	81	212	259	20
11	222	RED MEETING BLUE DEFENSE L2		3	10	0	5
		FRONTAGE 400M, DEPTH 2800M, RANGE 1000M					
		RED MOVING, BLUE STATIONARY	TOTAL	84	222	259	25
11	223	RED MEETING BLUE DEFENSE L3		2	10	42	5
		FRONTAGE 400M, DEPTH 3400M, RANGE 400M					
		RED MOVING, BLUE STATIONARY	TOTAL	86	232	301	30

OUTPUT FROM PROGRAM SELECT.MRR: SITUATIONALLY RELATED ENGAGEMENT SETS
(Continued)

12	321	RED MEETING BLUE ATTACK L1	3	12	0	0
		FRONTAGE 400M, DEPTH 800M, RANGE 2000M				
		RED MOVING, BLUE MOVING TOTAL	89	244	301	30
12	322	RED MEETING BLUE ATTACK L2	3	11	0	0
		FRONTAGE 400M, DEPTH 400M, RANGE 1000M				
		RED MOVING, BLUE MOVING TOTAL	92	255	301	30
12	323	RED MEETING BLUE ATTACK L3	3	10	49	0
		FRONTAGE 400M, DEPTH 250M, RANGE 400M				
		RED MOVING, BLUE MOVING TOTAL	95	265	350	30
13	421	RED DEL. DEFENSE BLUE ATTACK L1	4	11	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 2000M				
		RED STATIONARY, BLUE MOVING TOTAL	99	276	350	30
13	422	RED DEL. DEFENSE BLUE ATTACK L2	4	10	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 1000M				
		RED STATIONARY, BLUE MOVING TOTAL	103	286	350	30
13	423	RED DEL. DEFENSE BLUE ATTACK L3	3	10	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 400M				
		RED STATIONARY, BLUE MOVING TOTAL	106	296	350	30
14	611	RED BREAKTHROUGH BLUE DEFENSE H1	9	2	0	2
		FRONTAGE 500M, DEPTH 150M, RANGE -400M				
		RED MOVING, BLUE STATIONARY TOTAL	115	298	350	32
14	612	RED BREAKTHROUGH BLUE DEFENSE H2	7	2	14	2
		FRONTAGE 500M, DEPTH 250M, RANGE -1000M				
		RED MOVING, BLUE STATIONARY TOTAL	122	300	364	34
14	613	RED BREAKTHROUGH BLUE DEFENSE H3	3	2	14	2
		FRONTAGE 500M, DEPTH 250M, RANGE -2000M				
		RED MOVING, BLUE STATIONARY TOTAL	125	302	378	36
15	521	RED WITHDRAWAL BLUE ATTACK L1	1	4	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 2000M				
		RED STATIONARY, BLUE MOVING TOTAL	126	306	378	36
15	522	RED WITHDRAWAL BLUE ATTACK L2	1	4	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 1000M				
		RED STATIONARY, BLUE MOVING TOTAL	127	310	378	36
15	523	RED WITHDRAWAL BLUE ATTACK L3	1	3	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 400M				
		RED STATIONARY, BLUE MOVING TOTAL	128	313	378	36

OUTPUT FROM PROGRAM SELECT.MRR: SITUATIONALLY RELATED ENGAGEMENT SETS
(Continued)

16	780	ENHANCEMENT: INDIRECT FIRE RANGE 400M					8
17	621	RED BREAKTHROUGH BLUE DEFENSE L1 FRONTAGE 500M, DEPTH 250M, RANGE -400M RED MOVING, BLUE STATIONARY	9 TOTAL	2 137	0 315	2 378	38
17	622	RED BREAKTHROUGH BLUE DEFENSE L2 FRONTAGE 500M, DEPTH 250M, RANGE -1000M RED MOVING, BLUE STATIONARY	8 TOTAL	2 145	0 317	2 378	40
17	623	RED BREAKTHROUGH BLUE DEFENSE L3 FRONTAGE 500M, DEPTH 250M, RANGE -2000M RED MOVING, BLUE STATIONARY	8 TOTAL	2 153	0 319	2 378	42
18	710	ENHANCEMENT: TACAIR FROGFOOT RANGE 400M					2
19	790	ENHANCEMENT: SMOKE RANGE 1000M					6
20	720	ENHANCEMENT: ATTACK HEL HIND-D ATGM RANGE 2000M					4
21	730	ENHANCEMENT: ATTACK HEL HIND-D ASLT RANGE 400M					4

END OF SELECTION PROGRAM.

OUTPUT FROM PROGRAM SELECT FOR MOTORIZED RIFLE REGIMENTS

SELECTION OF FORCE-ON-FORCE SCENARIO ENGAGEMENTS

	TASKS								
	01	02	03	04	05	06	07	08	09
DIFFICULTY	0.5	0.5	0.5	0.5	1.3	0.5	0.5	0.5	0.5
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.281	0.587	1.526	0.587	2.132	2.132	2.132
	10	11	12	13	14	15	16	17	18
DIFFICULTY	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.3	1.3
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.281	0.587	0.587	0.587	2.132	5.542	5.542
	19	20	21	22	23	24	25	26	27
DIFFICULTY	0.5	1.3	0.5	0.5	1.3	0.5	0.5	0.5	1.3
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.731	0.281	0.587	1.526	0.587	2.132	2.132	5.542
	28	29	30	31	32	33	34	35	36
DIFFICULTY	0.5	0.5	1.3	0.5	0.5	0.5	0.5	0.5	0.5
IMPORTANCE	1	2	3	1	2	3	1	2	3
PROFICIENCY	40	40	40	60	60	60	90	90	90
INITIAL LEVEL	0.281	0.281	0.731	0.587	0.587	0.587	2.132	2.132	2.132

CALCULATING AT STEP 1 OF 15 ...

CALCULATING AT STEP 2 OF 15 ...

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OUTPUT FROM PROGRAM SELECT.MRR: SELECTION OF FORCE-ON-FORCE SCENARIOS

ENGAGEMENTS WERE SELECTED FOR TRAINING IN THE FOLLOWING ORDER:

STEP	ENGT	ENGAGEMENT DESCRIPTION		TANK	BMP	TROOPS	OTHER
1	100	RED ATTACK BLUE DEFEND INITIAL		12	28	0	0
		FRONTAGE 1500M, DEPTH 400M, RANGE 3000M					
		RED MOVING, BLUE STATIONARY	TOTAL	12	28	0	0
2	300	RED MEETING BLUE ATTACK INITIAL		4	12	0	0
		FRONTAGE 400M, DEPTH 800M, RANGE 3000M					
		RED MOVING, BLUE MOVING	TOTAL	16	40	0	0
3	200	RED MEETING BLUE DEFENSE INITIAL		4	11	0	6
		FRONTAGE 400M, DEPTH 800M, RANGE 3000M					
		RED MOVING, BLUE STATIONARY	TOTAL	20	51	0	6
4	740	ENHANCEMENT: ELECTRONIC WARFARE (EW)					1
		RANGE 400M					
5	400	RED DEL. DEFENSE BLUE ATTACK INITIAL		4	12	0	0
		FRONTAGE 500M, DEPTH 250M, RANGE 3000M					
		RED STATIONARY, BLUE MOVING	TOTAL	24	63	0	6
6	760	ENHANCEMENT: NBC ARTY BTY					6
		RANGE 400M					
7	770	ENHANCEMENT: OBSTACLE					3
		RANGE 400M					
8	750	ENHANCEMENT: NBC YAK-28					1
		RANGE 400M					
9	500	RED WITHDRAWAL BLUE ATTACK INITIAL		1	4	0	0
		FRONTAGE 100M, DEPTH 50M, RANGE 3000M					
		RED STATIONARY, BLUE MOVING	TOTAL	25	67	0	6
10	600	RED BREAKTHROUGH BLUE DEFENSE INITIAL		10	3	0	2
		FRONTAGE 500M, DEPTH 250M, RANGE 0M					
		RED MOVING, BLUE STATIONARY	TOTAL	35	70	0	8
11	780	ENHANCEMENT: INDIRECT FIRE					8
		RANGE 400M					
12	710	ENHANCEMENT: TACAIR FROGFOOT					2
		RANGE 400M					
13	790	ENHANCEMENT: SMOKE					6
		RANGE 1000M					

OUTPUT FROM PROGRAM SELECT.MRR: SELECTION OF FORCE-ON-FORCE SCENARIOS
(Continued)

14	720	ENHANCEMENT: ATTACK HEL HIND-D ATGM RANGE 2000M	4
15	730	ENHANCEMENT: ATTACK HEL HIND-D ASLT RANGE 400M	4

END OF SELECTION PROGRAM.

Appendix G

Subtask by Engagement Cluster Matrixes

Table G-1

Individual and Crew Subtask by Engagement Cluster Matrix

	Engagement Cluster											
	Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
2. Acquire Target												
2.1. Search/detect												
2.1.1. Choose sight	2	2	2	2	2	2	2	2	2	2	2	2
2.1.2. Daylight sight	2	2	2	2	2	2	2	2	2	2	2	2
2.1.3. Thermal sight	2	2	NG	NG	2	2	2	NG	NG	NG	NG	NG
2.1.4. Search closed-hatch	DF	DF	DF	DF	DF	DF	DF	DF	DF	DF	DF	DF
2.1.5. Search open-hatch	2	2	2	2	2	2	2	2	2	2	2	2
2.2. Locate/ID target	-	2	2	2	-	2	2	2	2	2	2	2
2.3.1. Estimate range visually	-	M	M	M	-	M	M	M	M	M	M	M
3. Issue Fire Command												
3.1. Standard fire command												
3.1.1. Issue std fire command	-	2	2	2	-	2	2	2	2	2	2	2
3.1.2. Lay main gun for direction	-	2	2	2	-	2	2	2	2	2	2	2
3.1.3.1 Spec. dir. verbal	-	M	M	M	-	M	M	M	M	M	M	M
3.1.4. Specify range	-	M	M	M	-	M	M	M	M	M	M	M
3.2. Issue battlesight	-	-	GM	GM	-	-	2a	2b	2	2	2	GM
3.3. Specify mutiple target	-	2	2	2	-	2	2	2	2	2	2	2
3.4. Specify simultaneous	-	-	2	2	-	-	2	2	2	2	2	-
4. Engage Single Main Gun Target												
4.1. Fire main gun												
4.1.1. Set FCS switches	-	2	2	2	-	2	2	2	2	2	2	2
4.1.2. ID target	-	2	2	2	-	2	2	2	2	2	2	2
4.1.3. Track	-	2	2	2	-	2	2	2	2	2	2	2
4.1.4. Lase	-	2	2	2	-	2	2	2	2	2	2	2
4.1.5. Fire	-	2	2	2	-	2	2	2	2	2	2	2
4.2. Maneuver												
4.2.1. Direct tank movement	-	2	2	2	-	2	2	2	2	2	2	2
4.2.2. Clear terrain mask	2	2	2	2	2	2	2	2	2	2	2	2
4.2.3. Maintain platform	-	-	-	-	-	2	2	2	2	2	2	2
4.2.4. Use cover and concealment	2	2	2	2	2	2	2	2	2	2	2	2
4.3. Load round	-	2	2	2	2	2	2	2	2	2	2	2
4.4. Observe												
4.4.1. Observe round	-	2	-	-	-	2	-	-	-	-	-	-
4.4.2. Observe effect	-	2	2	2	-	2	2	2	2	2	2	2
5. Engage [Single] COAX Target Precision												
5.1. Engage target												
5.1.1. Engage point	-	-	-	2	-	-	-	2	2	2	2	2
5.1.2. Engage area	-	-	-	2	-	-	-	2	2	2	2	2
5.2. Monitor ammo	-	-	-	2	-	-	-	2	2	2	2	2
6. Engage [Single] Target Degraded												
6.1. Choose technique												
6.1.1. Manually index range												
6.1.1.1. Toggle range	-	M	M	-	-	M	-	-	-	-	-	-
6.1.1.2. Enter CCP	-	M	M	-	-	M	-	-	-	-	-	-
6.1.2. Choose sight	M	M	M	M	M	M	M	M	M	M	M	M
6.1.3. Apply range in GAS	-	M	M	M	-	M	M	M	M	M	M	M
6.1.4. Lead moving target	-	M	M	M	-	M	M	M	M	M	M	M
6.1.5. Use manual controls	M	M	M	M	M	M	M	M	M	M	M	M
6.2. Use multiple return strategy	M	M	M	M	M	M	M	M	M	M	M	M

(table continues)

(Table G-1 continued)

	Engagement Cluster											
	Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
7. TC Engage [Single] Target												
7.1. Engage main gun												
7.1.1. Set switches	-	3	3	3	-	3	3	3	3	3	3	3
7.1.2. Track target	-	3	3	3	-	3	3	3	3	3	3	3
7.1.3. Lase	-	3	3	3	-	3	3	3	3	3	3	3
7.1.4. Fire	-	3	3	3	-	3	3	3	3	3	3	3
7.2. Engage COAX												
7.2.1. Point target	-	-	-	3	-	-	-	3	3	3	3	3
7.2.2. Area target	-	-	-	3	-	-	-	3	3	3	3	3
7.3. Engage Cal .50												
7.3.1. Apply range	-	-	2	2	-	-	2	2	2	2	2	2
7.3.2. Lead	-	-	2	2	-	-	2	2	2	2	2	2
7.3.3. Engage:												
7.3.3.1. Point target	-	-	2	2	-	-	2	2	2	2	2	2
7.3.3.2. Area target	-	-	2	2	-	-	2	2	2	2	2	2
8. LDR Engage [Single] Target												
8.2. Engage area target	-	-	-	T	-	-	-	T	T	T	T	T
8.3. Engage aerial target	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB
9. Engage Multiple Targets												
9.1. Engage main gun/COAX sequential												
9.1.1. Gunner's station												
9.1.1.1. Main gun	-	2	2	2	-	2	2	2	2	2	2	2
9.1.1.2. COAX	-	-	-	2	-	-	-	2	2	2	2	2
9.1.2. TC position												
9.1.2.1. Main gun	-	3	3	3	-	3	3	3	3	3	3	3
9.1.2.2. COAX	-	-	-	3	-	-	-	3	3	3	3	3
9.2. Engage Simultaneous Targets												
9.2.1. Main gun/cal .50	-	-	2	2	-	-	2	2	2	2	2	2
9.2.2. COAX/cal .50	-	-	-	2	-	-	-	2	2	2	2	2
10. Adjust Fire												
10.2. Give subsequent cmd (TC)	-	T	T	T	-	T	T	T	T	T	T	T
10.3. Employ adjustment (GNR)	-	T	T	T	-	T	T	T	T	T	T	T
11. Take Immediate Action												
11.1. Main gun misfire	-	M	M	M	-	M	M	M	M	M	M	M
11.2. COAX failure	-	-	-	M	-	-	-	M	M	M	M	M
11.3. Runaway COAX	-	-	-	M	-	-	-	M	M	M	M	M
11.4. Cal .50	-	-	M	M	-	-	M	M	M	M	M	M
11.5. Loader's M240	-	-	-	M	-	-	-	M	M	M	M	M
12. Employ Smoke												
12.1. Grenades	B	B	B	2	2	2	2	2	2	2	2	2
12.2. Exhaust	B	B	B	2	2	2	2	2	2	2	2	2
13. Report												
13.1. TC Report	2	2	2	2	2	2	2	2	2	2	2	2
13.2. PL/PSG Reports	2	2	2	2	2	2	2	2	2	2	2	2
14. Issue Platoon Fire Command	-	2	2	2	-	2	2	2	2	2	2	2
15. Request Indirect Fire												
15.1. Initiate	L	L	L	L	L	L	L	L	L	L	L	L
15.2. Lift/shift	L	L	L	L	Lc	Ld	Le	L	L	L	L	L

(table continues)

(Table G-1 continued)

	Engagement Cluster											
	Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
16. PLT Movement												
16.1. Technique	-	Lf	L	L	2	2	2	2	-	L	L	L
16.2. Formation	-	Lf	L	L	2	2	2	2	-	-	L	L
16.3. Direction	-	Lf	L	L	2	2	2	2	-	L	L	L

Note. Cell entries indicate whether the subtask is covered by engagements in the cluster See Table 4 for engagement descriptions.

Symbol	Meaning		
-	Subtask will not occur during engagements in cluster		
2	Subtask will occur during engagements in cluster		
Other:	Subtask will occur, given engagement modifications, or will occur under different conditions for engagements in cluster:		
3	Three-man crew	a	GM for engagements 4.2, 4.5, 5.2, and 5.5
A	Tactical air combat	b	GM for engagements 4.3, 4.6, 5.3, and 5.6
B	Enemy attack helicopter	c	"-" for engagement 4.0
D	Chemical environment	d	"-" for engagements 4.1 and 4.4
F	Enemy indirect fire	e	"-" for engagements 4.2 and 4.5
G	Smoke/obscuration	f	"-" for engagements 2.1 and 2.4
L	Platoon Leader/Platoon SGT command		
M	System malfunction		
N	Night		
T	Tank Commander command		

Table G-2

Platoon Collective Subtask by Engagement Cluster Matrix

	Engagement Cluster											
	Defense				Offense				Defense/Breakthrough			
	Distant	Long	Medium	Short	Distant	Long	Medium	Short	Zero	Short	Medium	Long
1. Travel in PLT Formation												
1.1. Wedge	-	Xa	X	X	X	Xb	Xc	-	-	X	X	X
1.2. Echelon	-	Xa	X	X	X	Xb	Xc	-	-	X	X	X
1.3. Line	-	Xa	X	X	Xd	2e	2f	2	-	X	X	X
1.4. Vee	-	Xa	X	X	X	X	X	X	-	X	X	X
1.5. Column/Staggered column	-	Ea	E	E	-	-	-	-	-	E	E	E
2. Execute Battle Drills												
2.1. Action drill	-	-	-	-	-	2	2	2	-	-	-	-
2.2. Contact drill	-	-	-	-	-	2	2	2	-	-	-	-
2.3. Air attack drill	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB
3. Bound by Section	-	-	X	X	X	X	X	-	-	X	X	X
4. Overwatch Bounding PLT	E	E	E	E	E	E	E	E	E	E	E	E
5. Occupy BP												
5.1. Initial	2	2	2	2	-	-	-	-	2	2	2	2
5.2. Subsequent	-	X	X	X	-	-	-	-	X	X	X	X
6. Maneuver within BP	-	2	2	2	-	-	-	-	2	2	2	2
7. Employ Fire Pattern												
7.1. Frontal	-	2	2	2	-	2	2	2	2	2	2	2
7.2. Cross	-	S	S	S	-	Sg	Sh	Si	S	S	S	S
7.3. Depth	-	S	S	S	-	Sg	Sh	Si	S	S	S	S
8. Employ Firing Technique												
8.1. Observed	-	2	2	-	-	-	-	-	-	-	-	-
8.2. Alternating	-	2	-	-	-	-	-	-	-	-	-	-
8.3. Simultaneous	-	2	2	2	-	2	2	2	2	2	2	2

Note. Cell entries indicate whether the subtask is covered by engagements in the cluster. See Table 4 for engagement descriptions.

Symbol	Meaning
-	Subtask will not occur during engagements in cluster
2	Subtask will occur during engagements in cluster
Other:	Subtask will occur, given engagement modifications, or will occur under different conditions for engagements in cluster:
A	Tactical air combat
B	Enemy attack helicopter
E	Obstacles
S	Special target array
X	Team Leader
a	"-" for engagements 2.1 and 2.4
b	"-" for engagements 4.1, 4.4, 5.1, and 5.4
c	"-" for engagements 4.2, 4.5, 5.2, and 5.5
d	"-" for engagement 5.0
e	X for engagements 3.1 and 3.4
f	X for engagements 3.2 and 3.5
g	"-" for engagements 4.1 and 4.4
h	"-" for engagements 4.2 and 4.5
i	"-" for engagements 4.3 and 4.6

Appendix H

Example of Decision Method for Selecting Engagements for Testing

In the following example, we walk through the decisions and actions required by the method. The reader is cautioned that this example is designed only for purposes of demonstration. You may not agree with the decisions made. The validity of the decisions themselves does not affect the validity of the actions taken as a result.

In this example, we have assumed that the testing is to be done using the PRIME (Precision Range Integrated Maneuver Exercise) system with MILES (Multiple Integrated Laser Engagement System) developed initially for Phantom Run at Fort Hood, Texas. (For a description of the system and Phantom Run, see Drucker, R. Campbell, Koger, and Kraemer, 1989.) For this example, the decisions and the steps in using the decision method might be as follows:

Decision 1: Are there any engagements or modifications that cannot be supported? (Or are there any that someone has decided will not be used?) Are there any additional constraints on engagement implementation?

Analysis of the Phantom Run/PRIME capabilities results in the following decisions concerning modifications that will not be supported.

A, B — Tactical air combat and enemy attack helicopters. Although there may be aircraft in the area that one could designate as enemy, they will not operate on the PRIME system, nor interact with platoons on the Phantom Run.

F — Enemy indirect fire. Simulation is weak at best; decision is made to not use this.

G — Smoke/obscuration. Although some smoke can be used, its use is restricted due to residential areas nearby. No live fire, so smoke and dust from impacts is also insufficient.

M — System malfunctions. Decision has been made that simulation of weapon system malfunctions is too artificial for realistic testing. Additionally, MILES is not a precision gunnery system, so the tank computer is not used; degraded mode gunnery cannot be realistically simulated.

For this example, assume that constraints at Phantom Run/PRIME are that only 50 target lifters are available. It is possible to lay out the target arrays in such a way that some of the same lifters can be re-used for subsequent scenarios. For this test, though, for simplicity, it has been decided that only 50 targets will be presented, one time each, throughout the test. There are no constraints on the types of targets that can be portrayed, except that all targets are stationary.

All other engagements and modifications can be supported as needed.

Decision 2: Of the individual and crew subtasks and the platoon collective subtasks, are there any that are not to be tested?

Individual/crew subtask 12.2, Employ Smoke -- Exhaust, is not to be tested because of the range's proximity to the road, town, and air field. Individual/crew subtask 12.1, Employ Smoke -- Grenades, is not to be tested because of safety considerations in using smoke grenades.

The two subtasks requiring lasing (4.1.4 and 7.1.3) will not be tested because use of MILES precludes use of the LRF. Similarly, subtasks 4.3, Load Round, 4.4.1 and 4.4.2, Observe Round and Observe Effect, and 5.2, Monitor Ammo, are not performed when MILES is used. Individual/crew subtasks under Adjust Fire, 10.2 and 10.3, will not be tested because of the artificiality of observing and adjusting using MILES. Platoon subtask 6.0, Maneuver Within BP, will only occur on Phantom Run if the Team Leader makes it happen; there are no advancing enemy forces to cue the task.

All other subtasks that can be tested, given the modification constraints above, will be tested.

Decision 3: Is firing necessary for every engagement?

For purposes of this example, we will assume that it has been decided that every selected engagement should required tank firing.

Decision 4: What is the maximum number of engagements that can be supported during testing?

For the example, assume that it has been determined that four engagements will be used.

Step 1a: If any engagements or modifications cannot (or will not) be supported, convert the cell entries to "-" in the Subtask by Engagement Cluster Matrix.

Step 1b: Likewise, if any subtasks are designated as not to be tested, line out the subtasks in the Subtask by Engagement Cluster Matrix.

Step 1c: If firing is required for every engagement, line out engagement clusters Defense Distant and Offense Distant.

Step 1d: If deletion of any engagements or modifications (Step 1a) results in any subtasks now being required by no engagements, line out those subtasks. (If this result is unacceptable, Decision 1 must be reconsidered.)

The resulting matrix, with cell entries converted to "-" and subtasks lined out as necessary, is shown at Table H-1. Subtasks that were lined out because of nonsupportable modifications are individual/crew subtasks 2.3.1, Estimate range visually; 3.1.3.1, Specify direction verbally; 3.1.4, Specify range; 6.1 - 6.2, Engage target degraded; 8.3, Engage aerial target; 11.1 - 11.5, Take immediate action; and platoon subtask 2.3, Air attack drill. Subtasks that were lined out because they cannot be realistically performed with MILES include individual/crew subtasks 4.1.4, Lase (Gunner); 4.3, Load round; 4.4.1, Observe round; 4.4.2,

Table H-1

Individual, Crew, and Platoon Subtask by Engagement Cluster Matrix Revised for Example on Phantom Run with PRIME and MILES

Individual and Crew Subtasks	Engagement Cluster: Defense Long	Defense Medium	Defense Short	Offense Long	Offense Medium	Offense Short	Defense/Breakthrough Zero	Defense/Breakthrough Short	Defense/Breakthrough Medium	Defense/Breakthrough Long
2. Acquire Target										
2.1. Search/detect										
2.1.1. Choose sight	2	2	2	2	2	2	2	2	2	2
2.1.2. Daylight sight	2	2	2	2	2	2	2	2	2	2
2.1.3. Thermal sight	2	N	N	2	2	N	N	N	N	N
2.1.4. Search closed-hatch	D	D	D	D	D	D	D	D	D	D
2.1.5. Search open-hatch	2	2	2	2	2	2	2	2	2	2
2.2. Locate/ID target	2	2	2	2	2	2	2	2	2	2
~~2.3.1. Estimate range visually~~										
3. Issue Fire Command										
3.1. Standard fire command										
3.1.1. Issue std fire command	2	2	2	2	2	2	2	2	2	2
3.1.2. Lay main gun for direction	2	2	2	2	2	2	2	2	2	2
~~3.1.3.1. Spec. dir. verbal~~										
~~3.1.4. Specify range~~										
3.2. Issue battlesight	-	-	-	-	2a	2b	2	2	2	-
3.3. Specify multiple target	2	2	2	2	2	2	2	2	2	2
3.4. Specify simultaneous	-	2	2	-	2	2	2	2	2	-
4. Engage Single Main Gun Target										
4.1. Fire main gun										
4.1.1. Set FCS switches	2	2	2	2	2	2	2	2	2	2
4.1.2. ID target	2	2	2	2	2	2	2	2	2	2
4.1.3. Track	2	2	2	2	2	2	2	2	2	2
~~4.1.4. Lase~~										
4.1.5. Fire	2	2	2	2	2	2	2	2	2	2
4.2. Maneuver										
4.2.1. Direct tank movement	2	2	2	2	2	2	2	2	2	2
4.2.2. Clear terrain mask	2	2	2	2	2	2	2	2	2	2
4.2.3. Maintain platform	-	-	-	2	2	2	2	2	2	2
4.2.4. Use cover and concealment	2	2	2	2	2	2	2	2	2	2
~~4.3. Load round~~										
~~4.4. Observe~~										
~~4.4.1. Observe round~~										
~~4.4.2. Observe effect~~										
5. Engage [Single] COAX Target Precision										
5.1. Engage target										
5.1.1. Engage point	-	-	2	-	-	2	2	2	2	2
5.1.2. Engage area	-	-	2	-	-	2	2	2	2	2
~~5.2. Monitor ammo~~										
~~6. Engage [Single] Target Degraded~~										
~~6.1. Choose technique~~										
~~6.1.1. Manually index range~~										
~~6.1.1.1. Toggle range~~										
~~6.1.1.2. Enter CCR~~										
~~6.1.2. Choose sight~~										
~~6.1.3. Apply range in GAS~~										
~~6.1.4. Lead moving target~~										
~~6.1.5. Use manual controls~~										
~~6.2. Use multiple return strategy~~										

(table continues)

(Table H-1 continued)

Individual and Crew Subtasks	Engagement Cluster: Defense Long	Defense Medium	Defense Short	Offense Long	Offense Medium	Offense Short	Defense/Breakthrough Zero	Defense/Breakthrough Short	Defense/Breakthrough Medium	Defense/Breakthrough Long
7. TC Engage [Single] Target										
7.1. Engage main gun										
7.1.1. Set switches	3	3	3	3	3	3	3	3	3	3
7.1.2. Track target	3	3	3	3	3	3	3	3	3	3
~~7.1.3. Lase~~										
7.1.4. Fire	3	3	3	3	3	3	3	3	3	3
7.2. Engage COAX										
7.2.1. Point target	-	-	3	-	-	3	3	3	3	3
7.2.2. Area target	-	-	3	-	-	3	3	3	3	3
7.3. Engage Cal .50										
7.3.1. Apply range	-	2	2	-	2	2	2	2	2	2
7.3.2. Lead	-	2	2	-	2	2	2	2	2	2
7.3.3. Engage:										
7.3.3.1. Point target	-	2	2	-	2	2	2	2	2	2
7.3.3.2. Area target	-	2	2	-	2	2	2	2	2	2
8. LDR Engage [Single] Target										
8.2. Engage area target	-	-	T	-	-	T	T	T	T	T
~~8.3. Engage aerial target~~										
9. Engage Multiple Targets										
9.1. Engage main gun/COAX sequential										
9.1.1. Gunner's station										
9.1.1.1. Main gun	2	2	2	2	2	2	2	2	2	2
9.1.1.2. COAX	-	-	2	-	-	2	2	2	2	2
9.1.2. TC position										
9.1.2.1. Main gun	3	3	3	3	3	3	3	3	3	3
9.1.2.2. COAX	-	-	3	-	-	3	3	3	3	3
9.2. Engage Simultaneous Targets										
9.2.1. Main gun/cal .50	-	2	2	-	2	2	2	2	2	2
9.2.2. COAX/cal .50	-	-	2	-	-	2	2	2	2	2
~~10. Adjust Fire~~										
~~10.2. Give subsequent cmd (TC)~~										
~~10.3. Employ adjustment (GNR)~~										
~~11. Take Immediate Action~~										
~~11.1. Main gun misfire~~										
~~11.2. COAX failure~~										
~~11.3. Runaway COAX~~										
~~11.4. Cal .50~~										
~~11.5. Loader's M240~~										
~~12. Employ Smoke~~										
~~12.1. Grenades~~										
~~12.2. Exhaust~~										
13. Report										
13.1. TC Report	2	2	2	2	2	2	2	2	2	2
13.2. PL/PSG Reports	2	2	2	2	2	2	2	2	2	2
14. Issue Platoon Fire Command	2	2	2	2	2	2	2	2	2	2
15. Request Indirect Fire										
15.1. Initiate	L	L	L	L	L	L	L	L	L	L
15.2. Lift/shift	L	L	L	Lc	Ld	L	L	L	L	L
16. PLT Movement										
16.1. Technique	Le	L	L	2	2	2	-	L	L	L
16.2. Formation	Le	L	L	2	2	2	-	-	L	L
16.3. Direction	Le	L	L	2	2	2	-	L	L	L

(table continues)

(Table H-1 continued)

Platoon Collective Subtasks	Engagement Cluster: Defense Long	Defense Medium	Defense Short	Offense Long	Offense Medium	Offense Short	Defense/Breakthrough Zero	Defense/Breakthrough Short	Defense/Breakthrough Medium	Defense/Breakthrough Long
1. Travel in PLT Formation										
1.1. Wedge	Xe	X	X	Xf	Xg	-	-	X	X	X
1.2. Echelon	Xe	X	X	Xf	Xg	-	-	X	X	X
1.3. Line	Xe	X	X	2h	2i	2	-	X	X	X
1.4. Vee	Xe	X	X	X	X	X	-	X	X	X
1.5. Column/Staggered column	Ee	E	E	-	-	-	-	E	E	E
2. Execute Battle Drills										
2.1. Action drill	-	-	-	2	2	2	-	-	-	-
2.2. Contact drill	-	-	-	2	2	2	-	-	-	-
~~2.3. Air attack drill~~										
3. Bound by Section	-	X	X	X	X	-	-	X	X	X
4. Overwatch Bounding PLT	E	E	E	E	E	E	E	E	E	E
5. Occupy BP										
5.1. Initial	2	2	2	-	-	-	2	2	2	2
5.2. Subsequent	X	X	X	-	-	-	X	X	X	X
~~6. Maneuver within BP~~										
7. Employ Fire Pattern										
7.1. Frontal	2	2	2	2	2	2	2	2	2	2
7.2. Cross	S	S	S	Sc	Sd	Sj	S	S	S	S
7.3. Depth	S	S	S	Sc	Sd	Sj	S	S	S	S
8. Employ Firing Technique										
8.1. Observed	2	2	-	-	-	-	-	-	-	-
8.2. Alternating	2	-	-	-	-	-	-	-	-	-
8.3. Simultaneous	2	2	2	2	2	2	2	2	2	2

Note. Cell entries indicate whether the subtask is covered by engagements in the cluster. See Table 4 for engagement descriptions.

Symbol	Meaning
-	Subtask will not occur during engagements in cluster
2	Subtask will occur during engagements in cluster
Other:	Subtask will occur, given engagement modifications, or will occur under different conditions for engagements in cluster:
3	Three-man crew
D	Chemical environment
E	Obstacles
L	Platoon Leader/Platoon SGT command
M	System malfunction
N	Night
S	Special target array
T	Tank Commander command
X	Team Leader command
a	GM for engagements 4.2, 4.5, 5.2, and 5.5
b	GM for engagements 4.3, 4.6, 5.3, and 5.6
c	"-" for engagement 4.1 and 4.4
d	"-" for engagements 4.2 and 4.5
e	"-" for engagements 2.1 and 2.4
f	"-" for engagements 4.1, 4.4, 5.1, and 5.4
g	"-" for engagements 4.2, 4.5, 5.2, and 5.5
h	X for engagements 3.1 and 3.4
i	X for engagements 3.2 and 3.5
j	"-" for engagements 4.3 and 4.6

Observe effect; 5.2, Monitor ammo; 7.1.3, Lase (TC); 10.2, Give subsequent command (TC); and 10.3, Employ adjustment (GNR). Individual/crew subtasks 12.1 and 12.2, Employ smoke, also will not be tested. And engagement clusters Defense and Offense Distant have been deleted from the matrix, because firing is to be required on every engagement.

Step 2: Look first at the platoon collective subtasks in the revised Subtask by Engagement Cluster Matrix. Read across the row for each subtask, and note or highlight any subtasks which occur under only one engagement cluster. Tentatively select all of those engagement clusters which present the only opportunity for one or more subtasks.

Platoon subtask 8.2, Employ Alternating Fires, will occur only under engagements in cluster Defense Long, so it is selected.

Step 3: Still looking at the platoon portion of the matrix, read down the columns for the engagement cluster(s) selected in Step 2. Note or highlight any subtasks that are not included under any of the selected engagement clusters.

Defense Long does not cover platoon subtasks 2.1, Action Drill; 2.2, Contact Drill; and 3, Bound by section.

Step 4: Still looking at the platoon portion of the matrix, read across the row for subtasks not yet covered by selected engagement clusters, and tentatively select engagement clusters to cover those subtasks. Try to select the smallest number of engagement clusters to cover the remaining subtasks. Highlight or make a note of places where an engagement cluster that is selected to cover a subtask has a note on the cell entry; the note will indicate the engagements within the cluster that do not provide subtask coverage.

The three missing platoon subtasks are covered by Offense Long and Offense Medium. Just for variety, because the selected cluster comprises engagements at 2000 meters, we now select cluster Offense Medium, with engagements at 1000 meters. Note e and Note g taken together tell us that if we select engagement 2.1 or 2.4 (Meeting Engagement/Defense, Long) we will need engagement 3.2 or 3.5 (Meeting Engagement/Attack, Medium) in order to test platoon subtasks 1.1 and 1.2 (Wedge and Echelon PLT Formations). However, only two engagement clusters have yet been selected; it is not necessary to do more than highlight those notes for now.

Step 5: Now looking at the individual and crew subtask portion of the matrix, first note which subtasks are already covered by the engagement clusters selected in Steps 2, 3, and 4. Then repeat Steps 2, 3 and 4 for individual and crew subtasks. Note: If there are individual/crew subtasks that can only be tested under one engagement cluster, not already selected, check back to the platoon portion of the matrix. See whether or not that engagement cluster can be selected instead of one selected at Step 4, so that the individual/crew subtask and the platoon subtasks can be tested without increasing the number of engagements.

By testing from Defense Long and Offense Medium, there are several missing individual/crew subtasks, all having to do with firing of the COAX or the loader's M240 (5.1.1, 5.1.2, 7.2.1, 7.2.2, 8.2, 9.1.1.2, 9.1.2.2, 9.2.2). Either Defense or Offense Short will provide coverage, as will any of the Defense/Breakthrough clusters. We choose Defense Short, because it also gives coverage on some platoon subtasks where it would have been necessary otherwise to juggle engagements because of the restricting notes. Note a on subtask 3.2 (Issue battlesight) will require selection of engagements 3.2 or 3.5 (Meeting Engagement/Attack, Medium) from Offense Medium, at this point. Note e on subtasks 16.1, 16.2, and 16.3 (PLT Movement) for Defense Long would eliminate engagements 2.1 and 2.4 (Meeting Engagement/Defense, Long); but since those subtasks also occur under Defense Short, the restriction for Note e is immaterial.

Step 6: If there is some limit to the number of engagements that can be supported, then pause when that limit is reached (Steps 2 - 5). Note which subtasks are not yet covered by the engagement clusters already selected. To test those subtasks, you must either increase the number of engagements, or substitute other engagement clusters for those already selected, in order to cover the remaining subtasks. If the limit is greater than the number already selected (Steps 2-5), then select additional engagement clusters to provide more coverage of the most critical subtasks, or plan on selecting more than one engagement from selected clusters (in Step 9).

In this case, more engagements can be supported than are needed. Because of the restrictions noted on Steps 4 and 5, we decide to select one more engagement cluster without those restrictions, so that we will have a wider choice of engagements. Defense/Breakthrough Medium provides coverage of platoon subtasks 1.1, 1.2, and 1.5 (Wedge, Echelon, and Column Formations) which restricted selection from Defense Long, and of individual/crew subtask 3.2 (Issue battlesight), which restricted selection from Offense Medium.

Table H-2 reproduces the portions of the Subtask by Engagement Cluster Matrix for engagement clusters Defense Long, Defense Short, Offense Medium, and Defense/Breakthrough Medium. Notes are only included if they are still restrictive. That is, if a subtask restricts engagement selection in one cluster, but the subtask will occur in any engagement of another cluster, then the note is immaterial and has been removed. Cell entries from which the notes were removed are now shown in brackets to indicate that, depending on the engagement selected, that subtask might not be testable under the engagement (but will occur elsewhere).

Step 7: Once a set of engagement clusters has been selected, refer to Table 4, the list of engagements within clusters. Find the engagement clusters that were selected. If, in Step 4, you noted that particular engagements within clusters are needed in order to cover specific subtasks, note the particular engagement(s) needed on the table.

Having selected Defense Long, Defense Short, Offense Medium, and Defense/Breakthrough Medium, the engagement choices are those shown at Table H-3.

Table H-2

Individual, Crew, and Platoon Subtask by Selected Engagement Cluster Matrix for Example on Phantom Run with PRIME and MILES

Individual and Crew Subtasks	Engagement Cluster: Defense Long	Defense Short	Offense Medium	Defense/Breakthrough Medium
2. Acquire Target				
2.1. Search/detect				
2.1.1. Choose sight	2	2	2	2
2.1.2. Daylight sight	2	2	2	2
2.1.3. Thermal sight	2	[N]	2	[N]
2.1.4. Search closed-hatch	D	D	D	D
2.1.5. Search open-hatch	2	2	2	2
2.2. Locate/ID target	2	2	2	2
3. Issue Fire Command				
3.1. Standard fire command				
3.1.1. Issue std fire command	2	2	2	2
3.1.2. Lay main gun for direction	2	2	2	2
3.2. Issue battlesight	-	-	[2]	2
3.3. Specify multiple target	2	2	2	2
3.4. Specify simultaneous	-	2	2	2
4. Engage Single Main Gun Target				
4.1. Fire main gun				
4.1.1. Set FCS switches	2	2	2	2
4.1.2. ID target	2	2	2	2
4.1.3. Track	2	2	2	2
4.1.5. Fire	2	2	2	2
4.2. Maneuver				
4.2.1. Direct tank movement	2	2	2	2
4.2.2. Clear terrain mask	2	2	2	2
4.2.3. Maintain platform	-	-	2	2
4.2.4. Use cover and concealment	2	2	2	2
5. Engage [Single] COAX Target Precision				
5.1. Engage target				
5.1.1. Engage point	-	2	-	2
5.1.2. Engage area	-	2	-	2
7. TC Engage [Single] Target				
7.1. Engage main gun				
7.1.1. Set switches	3	3	3	3
7.1.2. Track target	3	3	3	3
7.1.4. Fire	3	3	3	3
7.2. Engage COAX				
7.2.1. Point target	-	3	-	3
7.2.2. Area target	-	3	-	3
7.3. Engage Cal .50				
7.3.1. Apply range	-	2	2	2
7.3.2. Lead	-	2	2	2
7.3.3. Engage:				
7.3.3.1. Point target	-	2	2	2
7.3.3.2. Area target	-	2	2	2
8. LDR Engage [Single] Target				
8.2. Engage area target	-	T	-	T

(table continues)

(Table H-2 continued)

Individual and Crew Subtasks	Engagement Cluster: Defense Long	Defense Short	Offense Medium	Defense/Breakthrough Medium
9. Engage Multiple Targets				
9.1. Engage main gun/COAX sequential				
9.1.1. Gunner's station				
9.1.1.1. Main gun	2	2	2	2
9.1.1.2. COAX	-	2	-	2
9.1.2. TC position				
9.1.2.1. Main gun	3	3	3	3
9.1.2.2. COAX	-	3	-	3
9.2. Engage Simultaneous Targets				
9.2.1. Main gun/cal .50	-	2	2	2
9.2.2. COAX/cal .50	-	2	-	2
13. Report				
13.1. TC Report	2	2	2	2
13.2. PL/PSG Reports	2	2	2	2
14. Issue Platoon Fire Command	2	2	2	2
15. Request Indirect Fire				
15.1. Initiate	L	L	L	L
15.2. Lift/shift	L	L	[L]	L
16. PLT Movement				
16.1. Technique	[L]	L	2	L
16.2. Formation	[L]	L	2	L
16.3. Direction	[L]	L	2	L
Platoon Collective Subtasks				
1. Travel in PLT Formation				
1.1. Wedge	[X]	X	[X]	X
1.2. Echelon	[X]	X	[X]	X
1.3. Line	[X]	X	[2]	X
1.4. Vee	[X]	X	X	X
1.5. Column/Staggered column	[E]	E	-	E
2. Execute Battle Drills				
2.1. Action drill	-	-	2	-
2.2. Contact drill	-	-	2	-
3. Bound by Section	-	X	X	X
4. Overwatch Bounding PLT	E	E	E	E
5. Occupy BP				
5.1. Initial	2	2	-	2
5.2. Subsequent	X	X	-	X
7. Employ Fire Pattern				
7.1. Frontal	2	2	2	2
7.2. Cross	S	S	[S]	S
7.3. Depth	S	S	[S]	S
8. Employ Firing Technique				
8.1. Observed	2	-	-	-
8.2. Alternating	2	-	-	-
8.3. Simultaneous	2	2	2	2

Table H-3

Engagements Within Clusters Selected for Example on Phantom Run with PRIME and MILES

Engagement Clusters	Engagement			
	Red/Blue Mission	Range	Red Loss Rate	Targets
Defense Long	1.1 Attack/Defense	2000m	High	33
	1.4 Attack/Defense	2000m	Low	37
	2.1 Meeting Engagement/Defense	2000m	High	17
	2.4 Meeting Engagement/Defense	2000m	Low	20
Defense Short	1.3 Attack/Defense	400m	High	20
	1.6 Attack/Defense	400m	Low	32
	2.3 Meeting Engagement/Defense	400m	High	10
	2.6 Meeting Engagement/Defense	400m	Low	17
Offense Medium	3.2 Meeting Engagement/Attack	1000m	High	10
	3.5 Meeting Engagement/Attack	1000m	Low	14
	4.2 Defense/Attack	1000m	High	10
	4.5 Defense/Attack	1000m	Low	14
	5.2 Withdrawal/Attack	1000m	High	3
	5.5 Withdrawal/Attack	1000m	Low	5
Defense/Breakthrough Medium	6.2 Breakthrough/Defense	1000m	High	11
	6.5 Breakthrough/Defense	1000m	Low	14

Step 8: If any of the engagements include requirements that cannot be supported (e.g, number and mix of threat targets), eliminate those engagements. (If whole engagement clusters that had been selected are thus eliminated, backtrack through Steps 2 - 6 to find an alternate engagement.)

Selection of engagements 1.1 or 1.4 (Attack/Defense, Long), or 1.6 (Attack/Defense, Short, Low Red Loss), which require 33, 37, or 32 targets (respectively) would make it impossible to test three more engagements from the remaining three clusters. Therefore, we would not pick those engagements. Engagement 1.3 (Attack/Defense, Short, High Red Loss), with 20 targets, cannot be presented in conjunction with engagement in each of the other three clusters, so it also would be eliminated. Although some balancing will be required in choosing among the other engagements, in order to not need too many targets, none of the engagements is in itself an unmanageable burden.

Step 9: Finally, from each selected engagement cluster, select one or more engagements (of those remaining) for testing.

Some sets that will work include:

Set	Defense Long	Defense Short	Offense Medium	Defense/Breakthrough Medium	Number of Targets
1	2.1	2.3	3.2	6.2	48
2	2.1	2.3	4.2	6.2	48
3	2.1	2.3	5.2	6.2	41
4	2.1	2.3	5.2	6.5	44
5	2.1	2.3	5.5	6.2	43
6	2.1	2.3	5.5	6.5	46
7	2.1	2.6	5.2	6.2	48
8	2.1	2.6	5.5	6.2	50
9	2.4	2.3	5.2	6.2	44
10	2.4	2.3	5.2	6.5	47
11	2.4	2.3	5.5	6.2	46
12	2.4	2.3	5.5	6.5	49

Further trial and error selection reveals that engagements 3.5 (Meeting Engagement/Attack, Medium, Low Red Loss) and 4.5 (Defense/Attack, Medium, Low Red Loss), each requiring 14 targets, cannot be tested along with even the smallest target arrays in the other three clusters.

We would select either Set 1 or Set 2, because they provide the most even distribution of targets across engagements. Set 8 would also be a preferred choice because it uses all of the available target lifters.

The engagement modifications that would be required include:

Chemical environment (D): For any one of the four engagements.
Three-man crew (3): Most likely in engagements from clusters Defense Short or Defense/Breakthrough Medium.

TC command (T): In clusters Defense Short or Defense/Breakthrough Medium; to require performance of individual/crew subtask 8.2 (Engage area target (LDR)).

PL/PSG command (L): In any engagement; to require performance of individual/crew subtasks 15.1 and 15.2 (Request indirect fire).

Team leader command (X): In cluster Defense Short; to require platoon subtasks 1.1, 1.2, 1.3, 1.4 (Wedge, Echelon, Line, and Vee Formations); 3 (Bound by section); and 5.2 (Occupy subsequent BP).

Obstacle (E): In cluster Defense Short or Defense/Breakthrough Medium; to require performance of platoon subtasks 1.5 (Column Formation) and 4 (Overwatch Bounding Platoon).

Special target arrays (S): In clusters Defense Long, Defense Short, or Defense/Breakthrough Medium; to require performance of platoon subtasks 7.2 and 7.3 (Cross and Depth Fires).